Vol. 9, No. 15
August 15, 1984

Energy Research Abstracts

Abstracts 27710-30095

Technical Information Center
Office of Scientific & Technical Information
UNITED STATES DEPARTMENT OF ENERGY

CURRENT AWARENESS PUBLICATIONS ON ENERGY

To provide complete coverage of literature related to major Department programs, announcement publications that are comprehensive in their coverage of certain energy fields are issued regularly. All information in these publications, plus additional backup information, is included in the Energy Data Base of the Technical Information Center; all references are also available for machine searching via the on-line retrieval system, DOE/RECON, and the commercial on-line retrieval systems. Descriptions of these current awareness publications, which are supported either directly or indirectly by the DOE, appear below. Department of Energy components may receive the listed publications free from the Technical Information Center, Office of Scientific and Technical Information, P. O. Box 62, Oak Ridge, TN 37831. Telephone (615) 576-1301; FTS 626-1301.

PUBLICATIONS OF THE TECHNICAL INFORMATION CENTER

Energy Abstracts for Policy Analysis (EAPA)

A monthly abstract journal devoted to the analysis of energy research, conservation, and policy. Scope and coverage are limited to substantive articles or reports and emphasize the following programmatic efforts; legislative, regulatc . . and other legal aspects; social, economic, and environmental impacts; regional and sectoral analyses; institutional factors, etc. *EAPA* is available from the Superintendent of Documents, U. S. Government Printing Office, Washington, D. C. 20402; domestic subscribers $6.00, foreign $7.50 per copy; annual cumulative index, domestic $10.00, foreign $12.50 per copy. The annual subscription price is $70.00 for domestic subscribers and $87.50 for foreign subscribers.

Energy Research Abstracts (ERA)

A comprehensive semimonthly abstract journal devoted to all areas of energy-related information produced by the Department of Energy, other U. S. government organizations, and foreign governments. *ERA* is available to the public on a subscription basis from the Superintendent of Documents, U. S. Government Printing Office, Washington, D. C. 20402. The subscription rate for the 24 semimonthly issues is $165.00 for domestic subscribers and $206.25 for foreign subscribers. A single issue costs $9.50 (domestic) or $11.90 (foreign).

DOE Patents Available for Licensing (PAL)

DOE is prepared to grant exclusive or nonexclusive, revocable licenses under DOE-owned U. S. patents and patent applications; this semiannual publication provides abstracting and indexing coverage of this literature. *PAL* is available on subscription as PB84-946800 from the National Technical Information Service, 5285 Port Royal Road, Springfield, VA 22161. The annual subscription price is $14.00 for domestic subscribers and $28.00 for subscribers outside the North American continent; prices for single issues are $7.00 and $14.00, respectively.

The following monthly update journals are available to the public on subscription from the National Technical Information Service, 5285 Port Royal Road, Springfield, VA 22161; use the identifying order number (PB- No.) when subscribing. The annual subscription rate for one volume (calendar) year (12 issues plus cumulative index) is $75.00 for domestic (North America) and $150.00 for foreign (outside North America) subscribers. A single issue is $7.00 (domestic) and $14.00 (foreign).

***Current Energy Patents (CEP)*–PB84-902800**

Provides coverage of the international patent literature, including patent applications, that concerns any aspect of energy production, conservation, and utilization.

***Energy and the Environment (EAE)*–PB84-914900**

Devoted to information on the impacts of energy-related activities and radioactive and nonradioactive pollutants on the environment.

***Fossil Energy Update (FEU)*–PB84-914600**

Devoted to information on the exploration, development, processing, and use of fossil fuels.

***Fusion Energy Update (CFU)*–PB84-915300**

Devoted to information on controlled thermonuclear fusion, including plasma and fuel research and power plant engineering and conceptual design studies.

***Solar Energy Update (SEU)*–PB84-914500**

Devoted to information on the utilization of solar energy, including biomass and tidal and wind power.

The following semimonthly bulletins are also available from the National Technical Information Service. The annual subscription rate for one volume (calendar) year (24 issues; no indexes) is $40.00 for domestic subscribers and $80.00 for subscribers outside the North American continent; use the identifying order number (PB- No.) when subscribing.

***Acid Precipitation (APC)*–PB84-901000**

Covers all aspects of acid precipitation, including effects and possible control measures.

***Coal-Based Synfuels (CBS)*–PB84-901400**

Covers all aspects of conversion of coal into gaseous or liquid fuels.

***Coal Preparation and Pollution Control (CPC)*–PB84-900800**

Covers all aspects of coal preparation and cleaning and reducing pollution from its direct combustion.

***Direct Energy Conversion (DEC)*–PB84-946600**

Covers the following areas: photovoltaics, magnetohydrodynamics, electrohydrodynamics, thermoelectrics, thermionics, and fuel cells.

***Geothermal Energy Technology (GET)*–PB84-914700**

Devoted to information on the exploration, development, and utilization of geothermal resources.

***Laser Research (LAR)*–PB84-901100**

Covers all aspects of laser research and development, but excludes applications.

***Nuclear Fuel Cycle (NFC)*–PB84-913400**

Covers all aspects of the nuclear fuel cycle, both front end and back end.

***Nuclear Reactor Safety (NRS)*–PB84-913500**

Covers the following safety aspects: accident analysis, safety systems, radiation protection, decommissioning and dismantling, and security measures.

***Radioactive Waste Management (RWM)*–PB84-902900**

Covers the following management aspects: transport and storage, waste processing, waste disposal, waste storage, radioactive effluents, and shipping containers.

***Solar Thermal Energy Technology (STT)*–PB84-901200**

Covers research in materials, concentrators/receivers, salinity gradients, etc., for development of efficient and reliable solar thermal conversion systems.

***Unconventional Petroleum (UCP)*–PB84-901300**

Covers all aspects of secondary and tertiary recovery of petroleum and of oil shales and tar sands.

INTERNATIONAL ENERGY PUBLICATIONS

The Office of Scientific and Technical Information, Technical Information Center (TIC) cooperates with the following organizations in the publication of international abstract journals: (1) International Atomic Energy Agency, International Nuclear Information System, Vienna, Austria, for *Atomindex;* (2) International Energy Agency, IEA Coal Research, London, England, for *Coal Abstracts;* and (3) International Energy Agency, Biomass Conversion Technical Information Service, Dublin, Ireland, for *Biomass Abstracts.* In each case, the cognizant foreign agency provides the non-U.S. information to TIC for inclusion in the Energy Data Base; in turn, TIC provides the U. S. information for input into the respective journal.

Atomindex

A semimonthly abstract journal providing worldwide coverage of information on nuclear science and technology. *Atomindex* is available by subscription from UNIPUB, 345 Park Avenue South, New York, NY 10010. The cost of an annual subscription, 24 semimonthly issues and semiannual and annual cumulative indexes, is $290.

Biomass Abstracts

A bimonthly abstract journal with comprehensive coverage of information in any step involved in the eventual conversion of biomass to energy. *Biomass Abstracts* is available free to Department of Energy components and contractors from the Technical Information Center. Non-DOE organizations may obtain *Biomass Abstracts* from Biomass Conversion Technical Information Service, Institute for Industrial Research and Standards, Ballymun Road, Dublin 9, Ireland, for 42 IR pounds per year. Make checks payable to the Institute.

Coal Abstracts

A monthly abstract journal providing comprehensive worldwide coverage of information in the field of coal science and technology. *Coal Abstracts* is available to Department of Energy components and contractors from the Technical Information Center. Non-DOE organizations may obtain *Coal Abstracts* from IEA Coal Research, Technical Information Service, 14-15 Lower Grosvenor Place, London SW1W 0EX, England, for 100 pounds sterling per year.

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OSTI/TIC now uses two File or Order Number prefixes, DE and TI. The DE prefix is applied to those reports available from NTIS; the TI prefix is applied to those reports *not* available from NTIS. Reports with TI prefixes may be requested by DOE and its contractors from OSTI/TIC. Availability outside DOE is provided by the issuing organizations.

In recent issues of OSTI/TIC abstract journals and bulletins, TI numbers appear incorrectly in some citations, primarily for *sections of reports (analytics)*—either in addition to the correct DE number or replacing the DE number.

Example:

> (DOE/OR/03054-17, pp 225-243) **Variable-speed drives; suitability and selection.** Apr 1984. NTIS, PC A15/MF A01. Order Number DE84010969. TI84010969.

These assignments or replacements occurred inadvertently in computer processing of the records. In all such cases, *when NTIS appears* in the citation, the TI number should be disregarded or, if appearing alone, should be changed to a DE number.

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ENERGY RESEARCH ABSTRACTS

ABOUT THE TECHNICAL INFORMATION CENTER

The Office of Scientific and Technical Information, Technical Information Center in Oak Ridge, Tennessee, has been the national center for scientific and technical information for the Department of Energy (DOE) and its predecessor agencies since 1946. In developing and managing DOE's technical information program, the Center places under bibliographic control not only DOE-originated information but also worldwide literature on scientific and technical advances in the energy field and announces the source and availability of this information. Whereas the literature of science is emphasized, coverage is extended to DOE programmatic, socioeconomic, environmental, legislative/regulatory, energy analysis, and policy-related areas. To accomplish this mission, the Center builds and maintains computerized energy-information data bases and disseminates this information via computerized retrieval systems and announcement publications such as abstracting journals, bibliographies, and update journals. Direct access to the Center's most comprehensive data base, the Energy Data Base, is available to the public through commercial on-line bibliographic retrieval systems. The Energy Data Base and many of the Center's energy-related data bases are available to DOE offices and contractors and to other government agencies via DOE/RECON, the Department's on-line information retrieval system. The Center has developed and maintains systems to record and communicate energy-related research-in-progress information, to maintain a register of DOE public communications publications, to track research report deliverables from DOE contractors, and to test and make available DOE-funded computer software programs with scientific and management applications. The Center also maintains a full-scale publishing capability to serve special publication needs of the Department. To effectively manage DOE's technical information resources, the Center's program is one of continual development and evaluation of new information products, systems, and technologies.

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ABOUT *ENERGY RESEARCH ABSTRACTS*

Energy Research Abstracts (ERA) provides abstracting and indexing coverage of all scientific and technical reports, journal articles, conference papers and proceedings, books, patents, theses, and monographs originated by the U. S. Department of Energy, its laboratories, energy centers and contractors. *ERA* also covers other energy information prepared *in report form* by federal and state government organizations, foreign governments, and domestic and foreign universities and research organizations. The user should remain aware that *ERA* coverage of non-report literature is limited to that generated by Department of Energy activity.

ERA is comprehensive in its subject scope, encompassing the DOE's research, development, demonstration, and technological programs resulting from its broad charter for energy sources, supplies, safety, environmental impacts, and regulation.

ERA is available on an exchange basis to universities, research institutions, industrial firms, and publishers of scientific information. Inquiries should be directed to the Office of Scientific and Technical Information, Technical Information Center, P. O. Box 62, Oak Ridge, TN 37831.

ERA is available to the public on a subscription basis from the Superintendent of Documents, U. S. Government Printing Office, Washington, D. C. 20402. The subscription rate for the 24 semimonthly issues is $165.00 for domestic subscribers and $206.25 for foreign subscribers. A single issue costs $9.50 (domestic) or $11.90 (foreign). The cumulative indexes will be available in printed form from the Superintendent of Documents, U. S. Government Printing Office, Washington, D. C. 20402, and in microfiche form from the National Technical Information Service, U. S. Department of Commerce, Springfield, VA 22161, and from Engineered Systems, P. O. Box 866, Oak Ridge, TN 37831.

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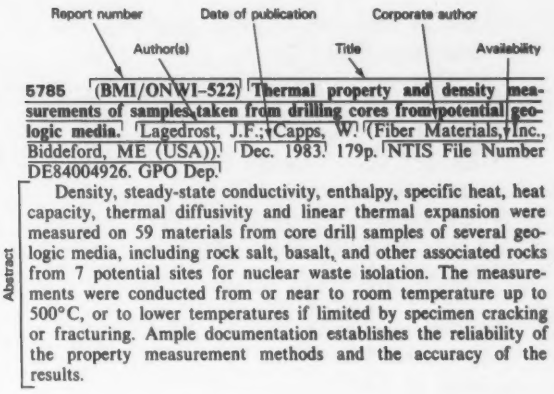
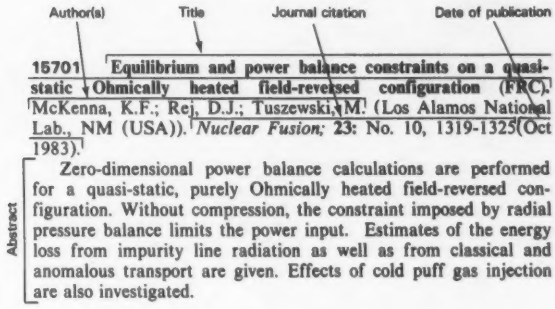
ABSTRACTS IN *ENERGY RESEARCH ABSTRACTS*

The principal elements of abstract entries for a typical research and development report and a typical technical journal article are illustrated below.


Report number
Date of publication
Corporate author
Author(s)
Title
Availability
5785 (BMI/ONWI-522) Thermal property and density measurements of samples taken from drilling cores from potential geologic media. Lagedrost, J.F.; Capps, W. (Fiber Materials, Inc., Biddeford, ME (USA)). Dec. 1983. 179p. NTIS File Number DE84004926. GPO Dep.
Abstract
Density, steady-state conductivity, enthalpy, specific heat, heat capacity, thermal diffusivity and linear thermal expansion were measured on 59 materials from core drill samples of several geologic media, including rock salt, basalt, and other associated rocks from 7 potential sites for nuclear waste isolation. The measurements were conducted from or near to room temperature up to 500°C, or to lower temperatures if limited by specimen cracking or fracturing. Ample documentation establishes the reliability of the property measurement methods and the accuracy of the results.


Author(s)
Title
Journal citation
Date of publication
15701 Equilibrium and power balance constraints on a quasi-static Ohmically heated field-reversed configuration (FRC). McKenna, K.F.; Rej, D.J.; Tuszewski, M. (Los Alamos National Lab., NM (USA)). Nuclear Fusion; 23: No. 10, 1319-1325 (Oct 1983).
Abstract
Zero-dimensional power balance calculations are performed for a quasi-static, purely Ohmically heated field-reversed configuration. Without compression, the constraint imposed by radial pressure balance limits the power input. Estimates of the energy loss from impurity line radiation as well as from classical and anomalous transport are given. Effects of cold puff gas injection are also investigated.

INDEXES TO *ENERGY RESEARCH ABSTRACTS*

Five indexes are provided for approaching the contents of each issue of *Energy Research Abstracts (ERA)*. Each index is preceded by an introduction that details the organization of the index and the principles by which it was compiled. The reader is referred to these introductions for information not found in the index examples that follow.

• Corporate Author Index

Technical report literature is indexed using the name of the organization or institution responsible for the issuance of the report.

5785 (BMI/ONWI-522) **Thermal property and density measurements of samples taken from drilling cores from potential geologic media.** Lagedrost, J.F.; Capps, W. **(Fiber Materials, Inc., Biddeford, ME (USA)).** Dec. 1983. 179p. NTIS File Number DE84004926. GPO Dep.

is indexed as:

Fiber Materials, Inc., Biddeford, ME (USA)

• Personal Author Index

Each author's name is indexed in the form appearing on the document abstracted, with the exception that given names are reduced to initials:

Capps, W., *See* Lagedrost, J. F.
Lagedrost, J.F., Thermal property and density measurements of samples taken from drilling cores from potential geologic media, 9:5785 (R:US)
McKenna, K.F., Equilibrium and power balance constraints on a quasi-static Ohmically heated field-reversed configuration (FRC), 9:15701 (J:US)
Rej, D.J., *See* McKenna, K.F.
Tuszewski, M., *See* McKenna, K.F.

• Subject Index

The subject index consisting of entries naming specific materials, objects, and processes is arranged alphabetically. Document titles, informative phrases, or both specific to these entries are arranged alphabetically under the entries.

SALT DEPOSITS
Density
Thermal property and density measurements of samples taken from drilling cores from potential geologic media, 9:5785 (R;US)
REVERSED-FIELD PINCH
Energy Balance
Equilibrium and power balance constraints on a quasi-static Ohmically heated field-reversed configuration (FRC), 9:15701 (J;AT)

• Contract Number Index

DOE technical report literature is indexed using contract numbers. This index contains the contract number with corresponding abstract and report numbers.

AC06-76RL01830 **Fiber Materials, Inc., Biddeford, ME (USA)** 9:5785 BMI/ONWI-522

• Report Number Index

Technical report literature is also indexed using report numbers. This index includes information on where individual reports may be obtained. Patents and conference papers are indexed here as a matter of convenience. When a report is supplied under a File Number, that number is included in the availability statement. A File Number–Report Number Correlation is included for convenience.

BMI/ONWI-522 9:5785 **NTIS, PC A09/MF A01. File Number DE84004926, Distribution Category MN-70**

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SUBJECT CONTENTS (NUMERICAL LISTING)

Six-digit subject category numbers are used in the storage, retrieval, and manipulation of bibliographic information entered into DOE's computerized bibliographic information system. The six-digit category numbers are utilized as if they were three pairs of two-digit numbers, the first two pairs being used to arrange the abstract content of *Energy Research Abstracts*. The following listing includes the totality of the 40 first-level and 293 second-level subject categories used. Because each issue of *ERA* announces only those documents becoming available during a semimonthly period, some subject categories may not be represented in every issue. The complete subject category scheme with scope definitions and limitations is available as DOE/TIC-4584-R5 from NTIS for $9.50.

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ENERGY RESEARCH ABSTRACTS

01 COAL AND COAL PRODUCTS

27710 (DOE/FE/60181—1531) Low-rank coal research. Quarterly technical progress report, October-December 1983. (North Dakota Univ., Grand Forks (USA). Energy Research Center). May 1984. Contract FC21-83FE60181. 263p. NTIS, PC A12/MF A01; 1; GPO Dep. Order Number DE84011585.

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This report is a detailed review of the progress in research programs at the University of North Dakota Energy Research Center on low rank coals, involving especially: gasification pilot plant waste water treatment and reuse, hydrogen production, coal-water slurry production (and study of rheology of slurries and coal drying), combustion and fluidizied-bed combustion, flue gas characterization and purification, ashes and boiler fouling, fine coal preparation, ashes and slags characterization, chemical structure of low rank coal, moisture, supercritical solvent extraction, pyrolysis and devolatilization. (LTN)

27711 (PB—84-159359) Minerals yearbook, 1982. volume 1. metals and minerals. (Bureau of Mines, Washington, DC (USA)). 1984. 956p. NTIS, PC A99/MF E04.

See also PB82-180027.

This volume of the Minerals Yearbook, covering metals and minerals, contains 73 commodity or commodity group chapters with data on approximately 90 minerals that were obtained as a result of the mineral information gathering activities of the Bureau of Mines. In addition, the volume contains a chapter on mining and quarrying trends and a statistical summary.

0104 Processing

REFER ALSO TO CITATION(S) 27784, 27837, 27883, 28015, 28018, 28020, 28026, 28031, 28855, 28988, 30050

27712 (ANL/FE—83-30) Viscosity of coal slags as a function of composition, temperature, and oxygen partial pressure. Chen, J.; Greenberg, S.; Poeppel, R.B. (Argonne National Lab., IL (USA)). Mar 1984. Contract W-31-109-ENG-38. 26p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE84011583.

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The viscosities of 22 synthetic and three natural coal slags were measured as a function of temperature under oxygen partial pressures typical of slagging coal gasifier conditions ($\sim 10^{-8}$ to $\sim 10^{-9}$ atm) and, in some cases, under an ambient air environment. The viscosity of any given slag composition is a single-valued function of temperature and oxygen partial pressure and does not exhibit a hysteresis effect. The measured viscosities were significantly different from the viscosities one would predict from two of the more commonly used viscosity-composition-temperature correlations. The sensitivity of viscosity to oxygen partial pressure was greatest for slags with high iron content. 11 references, 4 figures, 2 tables.

27713 (BMFT-FB-T—83-292) Investigations of the feasibility of fabric filters at high temperatures and pressures for an energy saving method of gas purification. Weber, E.; Schulz, R. (Bundesministerium fuer Forschung und Technologie, Bonn (Germany, F.R.)). Dec 1983. 57p. (In German). NTIS (US Sales Only), PC A04/MF A01. Order Number DE84751590.

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With filtering separators known today it is possible to carry out a gas cleaning only at temperatures up to 550°C. New energy technologies, for example pressurized coal gasification, require hot gas cleaning at temperatures between 700 and 1000°C and more. Aim of the research project was the development and laboratory testing of a filtering separator to be applied in this range of temperatures. To solve this problem, 26 different filter media were developed and tested in a laboratory test facility. According to these investigations, 9 filter media appeared to be qualified for high temperature filtration. To examine these laboratory findings a pilot filter plant was disigned and realized in a subsequent project.

27714 (BMFT-FB-T—84-016) Report on the construction of the pilot plant for hydrogasification of coal as part of the PNP-project. Langer, H. (Bundesministerium fuer Forschung und Technologie, Bonn (Germany, F.R.)). Mar 1984. 65p. (In German). NTIS (US Sales Only), PC A04/MF A01. Order Number DE84751593.

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Coal gasification processes have been known and well-tested for a long time. A number of further developments are being worked out; the main targets are to increase the gasification pressure and to save feed coal. In the processes, which are developed within the framework of the project "Prototype Plant Nuclear Process Heat (PNP)", up to 40% of feed coal is saved. Further advantages are the increase of efficiency and the reduction in emissions specific to coal. One of these processes is the Hydrogasification of coal (in a fluidized bed), which represents a key technology for the production of synthetic natural gas (SNG). Hydrogasification of coal can be operated on either a conventional or nuclear basis. The first steps in developing the process were planning, construction, and operation of a semitechnical test plant with a design capacity of 0,4 tons "Raw Brown Coal"/h. 1.800 metric tons of lignite and hard coal were gasified in this semitechnical plant during an operation period of 27,000 h to September 1982. The promising results formed the basis for planning a pilot plant, which is the last step before the implementation on a large technical scale. Basic Engineering for this pilot plant was begun in mid-77 and was completed in mid-78. It was described in the research report ET 1023 A. The work on detail engineering in the second half of 78 was described in the research report ET 1023 B. This report deals with the construction of the pilot plant; the corresponding research project came to an end on 31. December 1982.

27715 (BMFT-FB-T—84-021) Coal liquefaction. Exxon donor solvent process + flexicoking program. Langhoff, J.; Wolowski, E.; Dohms, K.D. (Bundesministerium fuer Forschung und Technologie, Bonn (Germany, F.R.)). Mar 1984. 102p. (In German). NTIS (US Sales Only), PC A06/MF A01. Order Number DE84751592.

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The operation of the Exxon Coal Liquefaction Pilot Plant in Baytown/Texas had been completed on June, 20, 1982. The EDS-Process has demonstrated successful production of synthetic fuels from coal. The total project has been performed in a 5-Phase Program: - Phase I - Fundamental Research (1966-1973), - Phase II - Planning, Basic-Engineering (1974-1975), - Phase III - Detail-Engineering (1976-1977), - Phase IV - Procurement, Construction (1978-1979), - Phase V - Operation (1980-1982). The project management has been performed by Exxon Research and Engineering Company, Florham Park, New Jersey/USA. The total funds for this international project have been sponsored by - Department of Energy, - Exxon Comp. USA, - Electric Power Research Institute, - Phillips Coal Company, - Anaconda Minerals, - Japan Coal liquefaction Development Comp., - Ruhrkohle AG, - ENI. The Minister of Re-

search and Technology supported the participation of Ruhrkohle AG from 1979-1982.

27716 **(CONF-840570—4) Corrosion in coal gasification systems.** Natesan, K.; Bakker, W.T. (Argonne National Lab., IL (USA); Electric Power Research Inst., Palo Alto, CA (USA)). 1984. Contract W-31-109-ENG-38. 10p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE84011739.

From Materials for future energy systems conference; Washington, DC, USA (1 May 1984).

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Over the last 10 years, extensive research has been performed to evaluate the corrosion behavior of both metallic and refractory materials in multicomponent-gas and liquid-slag environments that are relevant to various coal gasification schemes. This paper examines the available information on metallic materials to give insight into the development of protective scales on alloy surfaces and causes of scale breakdown. Available long-term kinetic data on sound-metal loss are examined to evaluate the effects of alloy and gas chemistry on corrosion of materials in complex oxygen-sulfur atmospheres. In addition, the corrosion behavior of a variety of refractory materials after laboratory and pilot plant exposures is examined and wear mechanisms are discussed. From current knowledge of the process environments and of the behavior of metallic and refractory materials, a number of areas are identified for long-range research that can have significant impact on the design and performance of coal gasification plants. 10 figures.

27717 **(CONF-8405154—1) Effect of time/temperature history on char reactivity.** Katta, S.; Keairns, D.L. (Westinghouse Electric Corp., Madison, PA (USA). Synthetic Fuels Div.). 21 Nov 1983. Contract AC21-82MC19122. 34p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE84011499.

From American Institute of Chemical Engineers spring national meeting; Anaheim, CA, USA (20 May 1984).

Portions are illegible in microfiche products; Research Report 83-8E3-WHERE-R2.

The effect of heating rate, pyrolysis atmosphere, maximum heat treatment temperature (HTT) in different pyrolysis atmospheres used during char preparation, pressure of char preparation and holding time at maximum HTT on char reactivity was studied using Wyoming Sub C coal on a thermogravimetric analyzer (TGA). All these factors were found to have a marked influence on char reactivity. Reactivity data are presented with rate as a function of carbon conversion and carbon conversion as a function of time or dimensionless time. 11 references, 17 figures, 1 table.

27718 **(CONF-8405154—2) Slurry drying of coal in the EDS process.** Garnish, J.F.; Madden, P.C. II. (Exxon Research and Engineering Co., Florham Park, NJ (USA)). May 1984. Contract FC05-77ET10069. 27p. NTIS, PC A03/MF A01; GPO Dep. Order Number DE84011378.

From American Institute of Chemical Engineers spring national meeting; Anaheim, CA, USA (20 May 1984).

Tests conducted during (ECLP) operations provided a wealth of information on ways to improve operability and efficiency of the slurry drying system. Modifications to eliminate vapor entrainment at ECLP resulted in successful demonstration of slurry drying technology. Subsequent data analysis provided a representative coal drying model for use in design studies. Finally, design modifications evolved which will improve not only operability of the coal feed and slurry pumping systems but also the coal drying efficiency of the overall unit. As a result of knowledge gained from ECLP, a large-scale slurry drying unit may be designed with confidence. 9 references, 9 figures.

27719 **(DOE/CH/00016—1494) Calcium silicate cement sorbent for H_2S removal and improved gasification processes. Final report.** Yoo, H.J.; Steinberg, M. (Brookhaven National Lab., Upton, NY (USA)). Oct 1983. Contract AC02-76CH00016. 68p. NTIS, PC A04/MF A01. Order Number DE84000223.

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Based on the studies performed on the agglomerated cement sorbent (ACS) pellet for in-situ desulfurization of gases and for improved gasification, in low and medium Btu fluidized bed coal gasifier (FBG) systems, the following conclusions can be drawn: (1) The pelletization method by a drum pelletizer is a good way of agglomerating large sized (>20 US mesh) ACS pellets having high sorbent performance. (2) The ACS pellets have a sulfur capture capacity of about 60% at 950°C, are 100% regenerable, and so not lose reactivity during cyclic use. (3) The rate of sulfidation increases linearly with H_2S concentration in the feed gas stream up to 1.0%. (4) The rate of sulfidation first increases with temperature in an Arrhenius fashion in the temperature range of 800°C to 1000°C and then decreases with further increase in temperatures, giving rise to an optimum sulfidation temperature of about 1000°C. (5) The gasification of coal or coal char either with CO_2 gas or by partial oxidation in a 40 mm ID FBG shows that the gasification efficiency of coal (or coal char) is very much enhanced with the ACS pellets and with Greer limestone over the coal (or coal char) alone. There is, however, not much difference between the ACS pellets and Greer limestone in the degree of enhancement. (6) The gasification of coal by partial oxidation with air to low Btu gas in a 1-inch coal-fired FBG unit shows that in the temperature range of 800° to 900°C the efficiency of coal gasification is improved by as much as 40% when ACS pellets are used compared to the use of Greer limestone. At the same time the sulfur removal efficiency is increased from 50 to 65% with Greer limestone to over 95% with the ACS pellets.

27720 **(DOE/ET/10069—T89) EDS coal liquefaction process development: Phase V. Quarterly technical progress report, October 1-December 31, 1983.** (Exxon Research and Engineering Co., Florham Park, NJ (USA)). Apr 1984. Contract FC05-77ET10069. 187p. (FE—2893-129). NTIS (US Sales Only), PC A09/MF A01; 1; GPO Dep. Order Number DE84011495.

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The previous combustion and characterization work on CLPP bottoms has been extended to include three ECLP bottoms from bottoms recycle operation. While TGA results indicate that bottoms are less combustible than the parent coals, SFEU testing indicates the combustibility is improved significantly with finer feeds (confirmed in Full-Scale Burner Facility Tests by C-E). Higher NO/sub x/ emissions, lower than expected levels of dust in the flue gas and reduced NO/sub x/ with bottoms-coal blands suggest that actual flame temperatures from bottoms are higher than those from coal. Work continued on the EDS consolidation economic studies to update five sponsor coal screening studies to reflect state-of-the-art EDS design. A basis has been established for determining flush oil rates to pressure relief valves in slurry service. Based on a review of the applicable literature, ECLP operation, and petroleum refining experience, a rate of 0.1 feet/sec is adequate for valves not normally in direct contact with slurry. For valves in direct slurry contact, a rate of 1.0 feet/sec is necessary. EDS hybrid and bottoms-fired steam boiler technology is commercially ready for an EDS plant application, and Combustion Engineering, Inc. is prepared to offer commercial units with performance guarantees. This reflects successful resolution of all technical issues under the recently completed Hybrid Boiler Development Program.

27721 **(DOE/ET/13800—6) Impact of pilot plant operations and concurrent development efforts on the projected performance and economics of a commercial EDS facility.** Tomlinson, G.C.; Gray, D.; Neuworth, M.B. (Mitre Corp., McLean, VA (USA). METREK Div.). Feb 1984. Contract AC01-80ET13800. 108p. (MTR—83W235). NTIS, PC A06/MF A01; 1; GPO Dep. Order Number DE84008292.

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One of the initial efforts in Phase V of the EDS Development Effort was the projection of the technical performance and economics of producing coal liquids using EDS technology. The balance of Phase V, which has included operation of the 200-ton per day Exxon Coal Liquefaction Pilot Plant, has produced data which is expected to have a major impact on the design and operation of a commercial EDS facility. In this study, MITRE performs an independent assessment of the Phase V development effort and

projects its impact on projected yields, product quality, and cost of coal liquefaction produced from a commercial EDS facility.

27722 **(DOE/ET/14800—T6) Exploratory research on solvent refined coal liquefaction. Final technical progress report, FE/14800-35.** (Pittsburg and Midway Coal Mining Co., Denver, CO (USA)). Feb 1984. Contract AC22-79ET14800. 94p. NTIS, PC A05/MF A01; 1; GPO Dep. Order Number DE84012431.

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This report summarizes the technical activity under Contract DE-AC22-79ET14800, Exploratory Research on Solvent Refined Coal Liquefaction, between the US Department of Energy and The Pittsburg and Midway Coal Mining Co. Experimental work was performed at the Merriam, Kansas laboratory of The Pittsburg and Midway Coal Mining Co. Six coals and a coal blend, representing the Interior, Rocky Mountain, Eastern and Northern Great Plains Provinces, were processed in the SRC I and SRC II modes to study the relationship between coal properties and liquefaction behavior. Disposable catalysts and specific compounds were added to Loveridge, Kaiparowitz and Blacksville No. 2 coals during SRC II mode liquefaction. Kentucky 9/14, Indiana V and Loveridge coals were processed at short residence times (4 to 9 minutes) in the SRC I mode to evaluate the effects of temperature, pressure, residence time and disposable catalyst addition. Finally, coal from the Powhatan No. 1 Mine was evaluated as a feedstock for major coal liquefaction facilities. 18 figures, 20 tables.

27723 **(DOE/FE/55014—T8) Great Plains Coal Gasification Project. Technical quarterly report, 1st quarter, 1984.** (Great Plains Gasification Associates, Detroit, MI (USA)). May 1984. Contract FM02-82FE55014. 172p. NTIS, PC A08/MF A01; 1; GPO Dep. Order Number DE84010286.

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Activities remain on schedule to meet the Great Plains Coal Gasification project's full gas production date. Detailed engineering is complete for the gasification plant. The remaining engineering tasks, which include field support activities and special projects, will be performed by the Contractors' Field Engineering Group. A substantial amount of construction progress was achieved during the first quarter. It is currently projected that construction will be complete at the end of September, 1984. Start-Up operations are continuing at a rapid pace. Commissioning activities are proceeding very well. The only remaining plant permit is the Permit to Operate, which will be issued in late 1985. Quality Assurance/Quality Control activities included the development of welding procedures for Operations personnel, safety relief valve testing, and equipment turnover inspections. Mine development activities remain on schedule. Initial coal deliveries to GPGA commenced this quarter.

27724 **(DOE/FE/60181—1574) Low-rank coal research. Quarterly technical progress report, January-March 1984.** (North Dakota Univ., Grand Forks (USA). Energy Research Center). Apr 1984. Contract FC21-83FE60181. 285p. NTIS, PC A13/MF A01; 1; GPO Dep. Order Number DE84012133.

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Progress in research programs on low rank coal is reported under the following headings: Gasification wastewater treatment and reuse, hydrogen production, preparation of coal-water fuel slurries, coal liquefaction, 50/sub x//NO/sub x/ control, particualte characterization, cleaning of coal fines, fouling of boilers and heat exchangers, fluidized-bed combustion, combustion of fuel slurries, ash and slag characterization, molecular structure measurement of physical properties and moisture, supercritical solvent extraction, pyrolysis and devolatilization. (LTN)

27725 **(DOE/FE/60339—3) High sulfur coal research at the SIUC Coal Technology Laboratory. Quarterly progress report, January 1-March 30, 1984.** (Southern Illinois Univ., Carbondale (USA). Coal Extraction and Utilization Research Center). 1984. Contract FC22-83FE60339. 89p. NTIS, PC A05/MF A01; 1; GPO Dep. Order Number DE84010970.

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Research on high-sulfur coal which is taking place at the Coal Technology Laboratory at Southern Illinois University, Carbondale, is divided among four general categories: coal science, coal preparation, coal conversion, and coal utilization. The work in these four areas covers a broad spectrum of high-sulfur coal research from the very fundamental aspects of the coal through its physical beneficiation and possible conversion to its ultimate utilization and the overall economic modeling and examination of the critical points in the coal fuel cycle.

27726 **(DOE/MC/16026—1611) Coal gasification and tar conversion reactions over calcium oxide. Annual progress report, November 1, 1982-October 31, 1983.** Longwell, J.P.; Chang, C.S.; Peters, W.A. (Massachusetts Inst. of Tech., Cambridge (USA)). Jan 1984. Contract AC21-81MC16026. 42p. NTIS, PC A03/MF A01; GPO Dep. Order Number DE84012147.

Pyrolysis of freshly formed volatiles generated from a thin bed of 1 gm of Pittsburgh No. 8 bituminous coal was studied over the temperature range 400 to 800°C. The volatiles were carried downstream by a superimposed helium flow through a heated tubular reactor (~ 40 cm long) - either packed with a bed (~ 5 cm deep) of calcium oxide-coated-quartz, or left unpacked in control experiments. System pressure was ~1.2 to 1.3 atm. The volatiles residence time in the homogeneous phase was ~ 2.0 to 2.2 s, and contact time with the active stone was ~ 0.11 to 0.12s. The calcium oxide greatly increases the rates and extents of removal of tars evolved over the temperature range 250 to 700°C. The major products are coke, deposited on the CaO surface, hydrogen, and light hydrocarbon gases. The increases in hydrogen yield cannot be totally accounted for by the steam-carbon reaction (here catalyzed by the CaO), implying that calcium oxide acts as a dehydrogenation agent, removing H_2 from coal tar molecules to yield moieties which in turn eventually form coke. Higher absolute yields of methane are generally observed in the presence of calcium oxide. However, a lower relative yield of methane, i.e., per weight of tar converted, is generally found with the calcine. Analogous behavior is consistently observed in studies of the pyrolysis of methyl-substituted aromatic compounds. These effects are therefore considered to be a general feature of the pyrolysis reactions of aromatic compounds and compound mixtures over CaO. 29 references, 5 figures, 8 tables.

27727 **(DOE/MC/19163—T22) Great Plains ASPEN model development. Technical progress report, March 1-31, 1984 .** (Scientific Design Co., Inc., New York (USA)). 12 Apr 1984. Contract AC21-82MC19163. 557p. NTIS, PC A24/MF A01; 1; GPO Dep. Order Number DE84012846.

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During the period March 1, 1984 through March 31, 1984 work was performed on the following tasks: Task No. 1 simplified models and task No. 4 rigorous models (Area 1600-Phenosolvan); and Task No. 2 review of existing gasifier models. The Phenosolvan Area, section 1600 of the Great Plain's project, has been simulated on ASPEN. Work on the gasifier model has run into several last minute problems. It is expected that the model will be completed shortly.

27728 **(DOE/OR/03054—17) SRC-I quarterly technical report, January-March 1983.** (International Coal Refining Co., Allentown, PA (USA)). Apr 1984. Contract AC05-78OR03054. 330p. NTIS, PC A15/MF A01; 1; GPO Dep. Order Number DE84010969.

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Seventeen papers from this report have been entered individually into EDB and ERA. (LTN)

27729 (DOE/OR/03054—17, pp 1-15) **Study of coal dissolver costs: effects of using one rather than two vessels and of increasing the material strength.** Secrist, D.A. Apr 1984. NTIS, PC A15/MF A01. Order Number DE84010969. TI84010969

In SCR-I quarterly technical report, January-March 1983.

Obviously, weight is the primary problem in handling heavy-walled vessels. Because most fabrication shops have cranes that can lift up to 1,000 tons, vessels up to that weight present no unusual problems during fabrication. Diameters up to 16 ft are also not a problem in the shop, but wall thicknesses above 12 1/2 in. are difficult to handle. However, with the improved steels that are being developed today, a 14-in.-thick wall is probably feasible. Another factor to be considered is the detailed economic posture of various fabrication shops. On the basis of the work done, it was concluded that: (1) Increasing the vessel's inside diameter always decreased the total metal required, and thus decreased the total cost; (2) Two vessels were less expensive than one, given a constant reactor volume. The equivalent volume of the second dissolver hemispherical heads had to be made up by increasing the tangent-to-tangent length of the shell of the single dissolver. (For a given volume, a cylindrical shape requires more metal than a hemisphere; (3) The cost advantages for the stronger steel proposed by the MPC are significant compared to the costs for the current ASME design. The difference is approximately $1,300,000, or about a 15-18% savings. The ASME will probably approve this stronger variation of SA-387 Class 2 steel, within the near future, after testing and documentation have been completed. 2 references, 1 figure, 5 tables.

27730 (DOE/OR/03054—17, pp 17-63) **Response of a heavy-wall reactor vessel to a hot-spot thermal upset condition. Part I. Thermal/mechanical analyses.** Secrist, D.A.; Baumert, K.L. Apr 1984. NTIS, PC A15/MF A01. Order Number DE84010969. TI84010969

In SCR-I quarterly technical report, January-March 1983.

Satisfactory reactor operation over a normal 8000-hr operating period can be achieved with reasonable safety for an undetected 1000°F hot spot, presuming yearly internal inspections and other parameters as stated within this analysis. In addition, damage from stress rupture does not appear to be a problem for the vessel in the case of a 1000°F hot spot. Essentially no deformation occurs within the region surrounding the hot spot and to a 2 1/2-in. depth into the wall. The constraint of the colder portions of the wall and the remaining 8 in. of thickness is too strong to be overcome by the affected area. Conservative creep-rupture lifetimes are greater than 20,000 hr for metal directly underneath the hot spot area. The times for reducing tensile properties to minimum values exceed 100,000 hr everywhere, posing no threat to vessel service lifetime. In contrast, the 1100°F hot spot condition is predicted to cause significant creep-rupture damage directly under the hot spot area. Lifetimes less than 1000 hr extend 2 1/2 in. into the wall, increasing to 20,000 hr at 4 7/8 in., and to greater than 100,000 hr at 8 1/4 in. Inward deformation of the wall is expected. Reduction of tensile strength to design minimums will be achieved in approximately 3500 hr. Analyses of 1200 and 1300°F hot spots were not computed primarily because of present engineering model limitations. Based upon the 1000 and 1100°F results, it would appear that application of a 1300°F hot spot would seriously damage the vessel through the loss of tensile properties within 1-2 days. An inelastic analysis will be necessary to properly estimate the time dependency and magnitude of the resulting physical displacement. 15 references, 23 figures, 2 tables.

27731 (DOE/OR/03054—17, pp 65-101) **Evaluation of the DECHEMA proposal for an SRC-I thermophysical properties data base software system.** Tweed, M.J.; Gimson, G.D.; Phillips, E.M. (Air Products and Chemicals, Inc., Allentown, PA; International Coal Refining Co., Allentown, PA). Apr 1984. NTIS, PC A15/MF A01. Order Number DE84010969. TI84010969

In SCR-I quarterly technical report, January-March 1983.

As part of the post-Baseline design activities for the SRC-I Demonstration Project, DOE asked ICRC to develop a computerized thermophysical properties data retrieval system for efficient archiving and subsequent ready retrieval of data on SRC-I thermophysical properties. To fulfill this mandate, ICRC recognized the need to acquire a genergl-purpose information retrieval software system, capable of retrieving both textual and numeric data. Accordingly, ICRC initiated activities to: (1) identify candidate software systems; (2) establish the software requirements for this thermophysical data base application; and (3) develop a method to assess the capabilities of the candidates. This report specifically addresses the data base application requirements and the methods used in evaluating candidate systems, and presents the quantitative and qualitative results of an evaluation of the DECHEMA DETHERM-SDR Thermophysical Data Retrieval System. The results of this evaluation, using seven major technical criteria, established that the DECHEMA software system is ideally suited for the requirements of the SRC-I thermophysical data base project. Because this system has been used commercially for more than 3 years as a thermophysical data retrieval tool, it represents a proven commercial software product.

27732 (DOE/OR/03054—17, pp 103-147) **Preliminary phase equilibrium model for the SRC-I process.** Mathias, P.M.; Stein, F.P. (Air Products and Chemicals, Inc., Allentown, PA; Lehigh University, Bethlehem, PA). Apr 1984. NTIS, PC A15/MF A01. Order Number DE84010969. TI84010969

In SCR-I quarterly technical report, January-March 1983.

This report describes a preliminary phase equilibrium model developed by Air Products for International Coal Refining Company (ICRC). The model has been implemented in APCI's in-house version of the ASPEN PLUS simulator and will be used in the Post-Baseline design of the SRC-I process. The model should be considered preliminary since it is based entirely on data from the literature. The phase equilibrium model is an enhanced form of the Peng-Robinson (1976) equation. Two modifications to the model originally proposed by Peng and Robinson have been made. The first, which is relatively minor, is the extension of the temperature-dependent function designed to represent the vapor pressure of pure fluids. The original Peng-Robinson model was accurate for nonpolar but not for polar substances; the simple modification proposed overcame this problem. The second modification to the Peng-Robinson model is the incorporation of density-dependent, local-composition theory in order to describe the complex behavior exhibited by mixtures containing highly polar substances. For example, the enhanced model provides a good description of the liquid/liquid equilibria of some mixtures representative of water/coal-fluid mixtures. This report describes the application of the modified Peng-Robinson equation of state to the vapor pressure of pure fluids, the vapor/liquid equilibria of light-gas/coal-fluid mixtures, and the liquid/liquid equilibria of water/coal-fluid mixtures. Further, workable generalized correlations have been provided so that the coal-fluid mixture can be described as a set of pseudocomponents defined by boiling point and specific gravity. 16 references, 10 figures, 9 tables.

27733 (DOE/OR/03054—17, pp 149-165) **Steady-state process simulator for the SRC-I process: updated study and final recommendations.** Gariepy, R.L.; Gimson, G.D.; Tomkinson, W.S. (Air Products and Chemicals, Inc., Allentown, PA; International Coal Refining Co., Allentown, PA). Apr 1984. NTIS, PC A15/MF A01. Order Number DE84010969. TI84010969

In SCR-I quarterly technical report, January-March 1983.

A report previously published by ICRC addressed the need for a generalized process simulation program capable of performing steady-state heat-and-material-balance calculations for a complex coal conversion process such as SRC-I. Specifically, the report documented and evaluated the capabilities of the Advanced System for Process Engineering (ASPEN) simulator, developed by the Massachusetts Institute of Technology with Department of Energy funding. At the time that report was prepared (March 1981), the ASPEN simulator had been released in draft form, together with parts of its associated documentation, so that industrial testing could be performed. The 1981 evaluation reflects the preliminary nature of most of the ASPEN system at that time. The present study revises the previous judgments, taking into account the capabilities of ASPEN in its final public form and in its commercially available form, ASPEN PLUS, marketed and supported by ASPEN Technology, Inc. The revised evaluation shows that ASPEN PLUS has clear advantages for use by ICRC as a general process simulator. 1 reference, 3 tables.

27734 (DOE/OR/03054—17, pp 167-183) **Effect of feed coal variation on demonstration plant performance. Relationships between coal properties and liquefaction yields.** Hoover, D.S.; Bland, A.; Davis, B. (International Coal Refining Co., Allentown, PA; Univ. of Kentucky, Lexington). Apr 1984. NTIS, PC A15/MF A01. Order Number DE84010969. TI84010969

In SCR-I quarterly technical report, January-March 1983.

ICRC has been conducting a research program to study the effect of feed coal variation on SRC-I coal liquefaction. One of the underlying objectives of this program has been to investigate whether quantitative correlations between coal properties and liquefaction yields could be generated. Although ICRC's data base is still too small to generate highly significant relationships, data trends were investigated that might yield useful relationships. Studies this quarter clearly show that pyritic sulfur in clean coal has the strongest effect on liquefaction yields of western Kentucky coals. However, it is the dispersion of the pyrite in the coal, not the amount, that appears to have the maximum effect. The coal's geochemical maturity and petrographic composition also influence conversion and oil yield, although to a lesser degree. An equation has been developed from our results that is significant for the prediction of coal conversion. Because other yield parameters such as oil yield and hydrogen consumption are positively correlated with improved conversion, they can also be estimated with this equation, but with much less confidence. An additional characterization factor will be necessary to improve these quantitative relationships. 3 figures, 5 tables.

27735 (DOE/OR/03054—17, pp 185-207) **Round-robin study of distillation procedures.** Kingsley, I.S.; Moyer, J.D.; Sehweighardt, F.K. (International Coal Refining Co., Allentown, PA; Air Products and Chemicals, Inc., Allentown, PA). Apr 1984. NTIS, PC A15/MF A01. Order Number DE84010969. TI84010969

In SCR-I quarterly technical report, January-March 1983.

ICRC is conducting an experimental program to determine the most precise analytical procedures to define SRC-I process streams for process control and product characterization and, ultimately, to correlate data generated by ICRC and the SRC-I Advanced Coal Liquefaction Facility in Wilsonville, Alabama. Analytical procedures must be well-established and standardized in order to develop a meaningful data base and to provide operational control during start-up and operation of a coal liquefaction plant. The complexity and thermal and oxidation instability of SRC-I process stream samples warrant the need for standardized work-up methods. As part of the program to develop standard work-up procedures, ICRC conducted a round-robin study between four laboratories to compare and contrast three different distillation procedures used to quantify the amount of distillate (material boiling below 850°F). Each laboratory used its own distillation setup to distill a specially selected process stream sample from the Wilsonville pilot plant. The distillates were then analyzed by a new procedure, encapsulated simulated distillation by gas chromatography (GCSD), to quantify the <850°F fraction of the sample. Results showed that using different laboratory setups for the same distillation procedure will affect the amount of distillate generated; however, encapsulated GCSD will help to compensate for these differences and improve agreement between laboratory data. 4 references, 4 figures, 7 tables.

27736 (DOE/OR/03054—17, pp 209-223) **Elemental analysis round robin.** Schweighardt, F.K. Apr 1984. NTIS, PC A15/MF A01. Order Number DE84010969. TI84010969

In SCR-I quarterly technical report, January-March 1983.

Apparent difficulties in the determination of nitrogen, sulfur, and oxygen (by difference) at the Wilsonville Advanced Coal Liquefaction Facility laboratory prompted A. Rao of Wilsonville to suggest a cooperative investigation of nitrogen analysis. As part of program area 12.1.10, SRC Product Analysis, ICRC participated in the round robin analysis. Six samples from the hydrotreater unit operation process streams were selected as representative of materials routinely analyzed for elemental distribution. Each laboratory involved analyzed the product streams and three chemical standards prepared at Wilsonville. The objective of the investigation was to determine the range of analytical results for elemental nitrogen determined by different instrumental procedures and different analysts. The data show that the Wilsonville laboratory should consider reviewing their current elemental analysis sampling techniques (Perkin-Elmer 240 system). If the current instrument cannot be updated or if future samples have low nitrogen contents that cannot be detected with the present onstruments, a new method should be considered as a replacement or supplement. 1 figure, 6 tables.

27737 (DOE/OR/03054—17, pp 225-243) **Variable-speed drives: suitability and selection.** Apr 1984. NTIS, PC A15/MF A01. Order Number DE84010969. TI84010969

In SCR-I quarterly technical report, January-March 1983.

This study was conducted to examine the suitability of variable-speed drives for three major reciprocating pump services and to recommend those drives that most effectively meet the requirements of the SRC-I Demonstration Plant. Mechanical and electrical drive variators were compared for costs and applicability. For the three pump services examined, electric speed variators were clearly superior. The AC drive systems are recommended for this project because of the following advantages, listed in order of priority: (1) energy savings; (2) flexibility; (3) first cost and installation savings. Flexibility advantages of the AC drive system are intangible because dollar values cannot be assigned; however, for the ultimate goals of this project, the available flexibility could emerge as a major value. Total capitalized dollar savings for the three pump services (12 installed drivers, 8 operating) in this study are: Energy savings: - $1,998,980; and First costs: - $753,360; for a total equal to $2,752,340. Large reciprocating pumps present a formidable challenge to the drive system, even when single speed. Where process variables demand changes, the best answer to this challenge is the wound rotor motor with static, solid-state, slip recovery. Other candidates are available for variable-speed pump drives, but were not included in this study. 4 figures.

27738 (DOE/OR/03054—17, pp 245-255) **Pulverized coal metering.** Apr 1984. NTIS, PC A15/MF A01. Order Number DE84010969. TI84010969

In SCR-I quarterly technical report, January-March 1983.

The SRC-I Demonstration Plant design calls for a pulverized coal feed rate of 250 tph. Each of two parallel streams deliver 125 tph of 70% through 200 mesh pulverized coal on a known-weight basis to separate slurry mix tanks. The pulverized coal is abrasive, aerates and becomes floodable, tends to pack and bridge following deaeration, and is an explosion and fire risk. Thus, materials handling systems design must consider suitable equipment, equipment arrangement, and control to properly feed the coal at the desired rate. Recommendations should include equipment having known capability and reliability in systems of similar capacity handling similar materials. A study was conducted to determine the most efficient system for feeding 250 tons per hour (.ph) of coal to slurry mix vessels. Three schemes having the greatest potential for successful operation were compared. Scheme II, a system including a mass-flow bin, Sankyo flow meter, and rotary valves, was recommended. This system does not require 100% dedication of the pulverizers to slurry mix. In addition, calibration and flow measurement are accomplished on-line with pulverized coal receiving bin load cells. Finally, successful installations with similar rates and product handled exist for the equipment items included in Scheme II. 3 figures, 3 tables.

27739 (DOE/OR/03054—17, pp 257-267) **Ash pond cost study.** Apr 1984. NTIS, PC A15/MF A01. Order Number DE84010969. TI84010969

In SCR-I quarterly technical report, January-March 1983.

This study was initiated to determine the cost and schedule impacts of designing the ash ponds for the SRC-I Demonstration Plant as hazardous rather than nonhazardous waste landfills. The estimated total cost to design and construct the ash ponds included in the Phase 0 estimate as hazardous waste secure landfills is $4.8 million. This total represents an increase of $2.4 million over those costs estimated in Phase 0 (escalated to 1980 dollars) to design and construct the same ponds as nonhazardous landfills. The schedule impact would consist primarily of extending the ash pond construction duration to 3 months, since the leachate system, dike construction, and synthetic lining installation would be sequential activities. However, overall impact to the construction schedule is minimal. Although additional engineering manhours would be required to

accomplish this design, the design durations would remain unchanged and the engineering schedule is not affected. 4 figures.

27740 (DOE/OR/03054—17, pp 271-287) **Zero-discharge study.** Apr 1984. NTIS, PC A15/MF A01. Order Number DE84010969. TI84010969

In SCR-I quarterly technical report, January-March 1983.

The purpose of this study was to determine the major cost and schedule impacts on the SRC-I project of installing a zero-wastewater-discharge system. This study does not attempt to optimize the best alternative method for achieving zero discharge or to investigate all the impacts that might result from the installation of a zero-discharge system. Rust Engineering compared two evaporator alternatives, namely multiple effect (ME) and vapor recompression (VR) systems. Initial analysis indicated that although total projected annual and capital costs of the ME alternate were lower, the lower variable cost of the VR alternate would tend to favor VR after 5 years of service. Similarly, two sensitivity analyses, involving a 30% increase in throughput and an increase in steam cost from $1.42 to $1.90/1000 lb showed higher total projected annual and capital costs for the VR alternate, but lower variable costs. It was concluded that total costs for both alternates were very similar, and that no selection should be made until additional engineering design is completed. 3 references, 2 figures.

27741 (DOE/OR/03054—17, pp 299-306) **Comparison of hydrobin and gantry green-coke handling systems for the SRC-I demonstration plant.** Apr 1984. NTIS, PC A15/MF A01. Order Number DE84010969. TI84010969

In SRC-I quarterly technical report, January-March 1983.

This study is based on producing 975 tons per day (wet basis) of SRC coke from a delayed coker. It is assumed the green or raw coke will contain 9 to 11 wt % volatile combustible matter, 15 to 20 wt % moisture (after initial draining), and have a bulk density of 45 lb/ft^3. Lummus studied and recommends hydrobin systems used by Mobile Oil Co., Paulsboro, New Jersey, and by Deurag-Nerag, Misburg, Germany. The hydrobin system is a slurry method for handling coke. As they drop from the coke drum, coke and cutting water fall into a rail-mounted portable coke feeder/crusher car, which reduces large lumps to a size suitable for pumping (in this case 2 to 3 in.). It also controls the flow of coke to the sluiceway located below the car. As the coke falls into the sluice, it is conveyed to the sump by the cutting water, supplemented by an additional regulated stream of water entering the sluice. The coke and water are pumped from the sump by a coke slurry pump. The mixture is discharged directly into a hydrobin, which is a separating vessel for the coke and water. The overflow water flows by gravity from the hydrobin to the clarifier, from which the clear water is pumped to the clear water tank for reuse in coke cutting and coke drum cooling. When all the coke has been removed from the coke drum, the decanting valves are opened on the hydrobin, and the remaining water is drained to the clarifier.

27742 (DOE/OR/03054—17, pp 307-317) **Air separation unit (AUU) trade-off study: three vs. two parallel trains.** Apr 1984. NTIS, PC A15/MF A01. Order Number DE84010969. TI84010969

In SRC-I quarterly technical report, January-March 1983.

The Phase O design for the SRC-I Demonstration Plant includes a two-train air separation unit (ASU) for the production of 1400 tons per day (tpd) of gaseous oxygen and nitrogen. In 1980, at ICRC's request, Air Products and Chemicals compared the economics of switching to a three-train ASU. Within the accuracy of the estimate, the results indicate that capital costs and power consumption for either two 700-tpd or three 467-tpd ASUs are essentially equal. However, Air Products strongly recommends the three-train ASU for the SRC-I plant based on two other noneconomic factors: (1) the potential for increased reliability and flexibility inherent with a three-train unit; (2) the increased risks associated with design, shop fabrication, and transportation of two 700-tpd ASUs.

27743 (DOE/OR/03054—17, pp 319-328) **SRC plant reliability assessment final report.** Gibson, S.B. Apr 1984. NTIS, PC A15/MF A01. Order Number DE84010969. TI84010969

In SRC-I quarterly technical report, January-March 1983.

Plant reliability obviously contributes to the final volume of product produced. In the design of a new plant, rules of thumb, past practice, and engineering judgment are usually the techniques used to provide adequate reliability, which is assumed to be about 8000 hours per year or 91%. However, in the design of a plant having considerable novelty, rules of thumb may no longer be valid, since there is no past practice, and engineering judgment, which is based on experience, has no base. In addition, the scale of the SRC-I process is so large that even a 1% change in annual availability results in an approximate $2.75 million change in revenue. It was therefore deemed advisable to conduct a formal reliability program for the SRC-I Plant. However, the project was terminated before that program could be implemented. This report outlines the proposed reliability program, summarizes some of the problems encountered, and suggests some avenues of approach. It was concluded that gathering information from plants using similar equipment was the most promising data source. It was also concluded that a computer coupled with an appropriate program would be needed for the assessment.

27744 (DOE/OR/03054—17, pp 329-337) **Quantitative assessment of the merits of internal lining for the expanded-bed hydrocracker. Final report.** Gibson, S.B.; Girling, P.M. Apr 1984. NTIS, PC A15/MF A01. Order Number DE84010969. TI84010969

In SRC-I quarterly technical report, January-March 1983.

ICRC has conducted a study to assess the advantages of a lined vs. unlined expanded-bed hydrocracker (EBH) or LC-Finer. Lining the vessel does not result in increased safety, and is therefore not justified. To achieve ICRC safety goals, additional instrumentation is needed to imvrove the probability of hot-spot detection and correction.

27745 **(DOE/OR/03054—26) SRC-I quarterly technical report, April-June 1983.** (International Coal Refining Co., Allentown, PA (USA)). Apr 1984. Contract AC05-78OR03054. 401p. NTIS, PC A18/MF A01; 1; GPO Dep. Order Number DE84010871.

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27746 (DOE/OR/03054—26, pp 3-41) **Filtration ash drying study.** Apr 1984. NTIS, PC A18/MF A01. Order Number DE84010871. TI84010871

In SRC-I quarterly technical report, April-June 1983.

During Phase 0 of the SRC-I 6000-ton-per-day Demonstration Plant project, the alternative deashing systems of filtration and Kerr-McGee critical solvent deashing were evaluated. During this evaluation, a study was conducted to determine the best design for drying the MAR produced by the filters. After filtration, the MAR cake remaining on the filter leaves contains approximately equal weights of liquid and solids. The liquids consist mainly of process solvent and SRC, which must be recovered to maintain solvent balance and improve SRC product yield. This is accomplished by displacing the heavier liquids (i.e., process solvent and SRC) with lighter solvent in the washing step. The cake is then dried to recover the lighter wash solvent and as much remaining process solvent as possible. In the fluidized-bed drying scheme, the filter cake is washed primarily to recover SRC. Process solvent adhering to the cake will be recovered in the fluidized bed. This report compares and evaluates the single and dual fluidized-bed MAR drying schemes. 7 references, 3 figures, 4 tables.

27747 (DOE/OR/03054—26, pp 45-54) **Comparison of coke calcining systems: rotary kiln (petrocarb) vs. rotary hearth (Marathon-Wise-Salem).** Apr 1984. NTIS, PC A18/MF A01. Order Number DE84010871. TI84010871

In SRC-I quarterly technical report, April-June 1983.

Lummus conducted a study to determine the most feasible coke calcining system for the SRC-I Demonstration Plant. The characteristics and requirements of Petrocarb's rotary kiln system were compared to those of Marathon-Wise-Salem's rotary hearth

system. Results indicated that, from an economic standpoint, the Petrocarb system was more feasible than the Salem-Wise system.

27748 (DOE/OR/03054—26, pp 57-71) **Kerr-McGee MAR case vs. Filter Cake MAR (BASE) case.** Apr 1984. NTIS, PC A18/MF A01. Order Number DE84010871. TI84010871

In SRC-I quarterly technical report, April-June 1983.

The makeup hydrogen requirement for the 6000-ton-per-day (tpd) SRC-I Demonstration Plant is provided by processing synthesis gas generated by gasifying a mixture of Kentucky No. 9 coal and mineral ash residue (MAR). MAR from two potential deashing processes, namely filter cake and Kerr-McGee, is evaluated in this trade-off study. The Texaco coal gasification process with total direct gas quench is selected to gasify the coal/MAR mixture. Parsons conducted a study to evaluate the effect on downstream processing units of gasifying a mixture of mineral ash residue (MAR) from two alternative deashing processes. The results of this evaluation and other similar studies were intended to assist in the selection of filtration or Kerr-McGee deashing to achieve mineral ash separation in the SRC-I Demonstration Plant. The study showed that the cold gas efficiency for the Kerr-McGee case is 63.8% compared with 57.2% for the base (filtrate) case. This significant efficiency improvement with the Kerr-McGee process results from the higher carbon and hydrogen content of the MAR, as well as a lower ash content. The higher quality MAR also reduced the amount of supplemental coal needed to produce the required product hydrogen. Kerr-McGee construction costs are $1.44 million more due to a 14% increase in the makeup hydrogen required, and a similar increase in the hydrogen compression area due to a 50% overall increase in the recycled hydrogen rate. In addition, the diethanolamine unit is $0.37 million more for the Kerr-McGee case due to the requirement to process 42% more high-pressure recycle gas through the DEA, and a 16% increase in the low-pressure feed gas rate to the DEA. 2 figures, 1 table.

27749 (DOE/OR/03054—26, pp 75-88) **Revised feed case vs base case using Texaco gasification.** Apr 1984. NTIS, PC A18/MF A01. Order Number DE84010871. TI84010871

In SRC-I quarterly technical report, April-June 1983.

In July 1980, the makeup hydrogen requirement for the 6000-tpd SRC-I Demonstration Plant was provided by processing synthesis gas generated by gasifying a mixture of Kentucky No. 9 coal and filter cake mineral ash residue (MAR). This report evaluates the effect of revising the filtration deashing MAR feed compositions and flow rates (because of design decisions made between December 1978 and late March 1979). The original design (Base Case) is compared with the revised feed rates (Revised Feed Case). The coal/MAR mixture is gasified by the Texaco coal gasification process with total gas quench. For comparison, a total plant concept for the production of hydrogen from coal and MAR has been considered. Therefore, facilities for oxygen production, coal and MAR gasification, shift, acid gas removal (Selexol unit), sulfur recovery, and hydrogen compression have been included in the evaluation. Similar process units downstream of the gasification section are used for evaluating both MAR feeds. The overall objective of this study is to compare the effects of revised feed streams and the Base Case feed streams in four areas: gasification, gas treating, product hydrogen compression, and sulfur recovery. The evaluation was made in terms of feed requirements, process capacity requirements, product purity, and overall utility and construction costs. The results of this evaluation have been combined with the results of similar evaluations on the remaining sections of the SRC facility in order to evaluate the effect of the revised feed streams over the Base Case feed streams for the entire plant. 2 tables.

27750 (DOE/OR/03054—26, pp 91-107) **Makeup hydrogen production from filter cake or Kerr-McGee ash concentrate using an alternative coal feedstock.** Apr 1984. NTIS, PC A18/MF A01. Order Number DE84010871. TI84010871

In SRC-I quarterly technical report, April-June 1983.

When filter cake is gasified (Base Case and Case I), supplemental raw coal is required to produce the makeup hydrogen. In contrast, when KMAC is gasified (Case II), supplemental coal is not needed, because KMAC produces surplus hydrogen, which is used as plant fuel. For comparison, a total plant concept for hydrogen production from coal and/or MAR has been considered. Therefore, facilities for oxygen production, coal and/or MAR gasification, shift, acid gas removal (Selexol unit), sulfur recovery, and hydrogen compression have been evaluated. Because of the differences in gas make in the SRC process area, the gas treating unit handling the recycle hydrogen and the low-pressure fuel gas streams is included in this evaluation. Sour water stripping is also included. The diethanolamine (DEA) unit is designed to remove acid gases contained in the high-pressure (HP) fuel gas streams and hydrogen-rich gas in the low-pressure (LP) fuel gas streams from the SRC process unit and the LP fuel gas stream from the coker/calciner unit. The ammonia sulfide water stripping unit is designed to process contaminated water originating in various units of the SRC facility. Both process units have been included in the evaluation of capital and operating cost differences because of variations in the gas feed streams and water feed streams for the three cases. The overall scope of this study includes gasification, gas treating, hydrogen compression, and sulfur recovery. Evaluation was made in terms of feed requirements, process capacity requirements, product purity, overall utility requirements, and construction cost requirements. 3 figures.

27751 (DOE/OR/03054—26, pp 111-141) **Selective vs nonselective acid gas removal processes.** Apr 1984. NTIS, PC A18/MF A01. Order Number DE84010871. TI84010871

In SRC-I quarterly technical report, April-June 1983.

The objective of this study is to compare and evaluate the overall economic impact and operability (i.e., installed cost and utility requirements) of two viable nonselective acid gas removal processes with respect to the selective acid gas removal Selexol process design. The approach is to develop plant designs in sufficient detail to estimate both construction and annual utility costs. The two nonselective acid gas removal options are: Alternate A - Selexol Process; and Alternate B - Benfield HiPure Process. In the nonselective Selexol process, the treatment of the makeup hydrogen will be a bulk removal of the acid gases to produce specification-quality hydrogen product. The H_2S-lean acid gases produced feed to a Selectox sulfur recovery unit that is added to the sulfur recovery facilities. A reduced-capacity Claus unit is required to process the acid gases from the DEA unit, which treats the SRC recycle hydrogen and low-pressure fuel gas streams. Tail gases from both the Selectox and Claus units feed to a Beavon sulfur removal unit for final sulfur recovery. The Benfield HiPure process is designed from proprietary data provided by Benfield Corporation, and employs a hot potassium carbonate absorption followed by DEA absorption for the final treatment of hydrogen. The results of the cost estimates reveal that Alternate A is more expensive than the base case design, in terms of both construction and utility costs. Although construction costs for Alternate B are less than those for the base case, the savings are more than eliminated by Alternate B's substantially higher utility costs. Thus, selective acid gas removal is economically more feasible than the two nonselective acid gas removal processes chosen for this study. 2 references, 3 figures, 8 tables.

27752 (DOE/OR/03054—26, pp 145-221) **Steam optimization study.** Apr 1984. NTIS, PC A18/MF A01. Order Number DE84010871. TI84010871

In SRC-I quarterly technical report, April-June 1983.

The Steam Optimization Study, was issued in December 1979, and was based on plant configuration data available at that time. During the subsequent detailed baseline design, substantial additional process data were developed. These data have shown that the economics of higher steam levels can be substantiated. Therefore, the current baseline steam conditions are: Superheated steam at 900 psig, 850°F and Saturated steam at 450, 150, 75, and 27 psig. This report is therefore outdated and superseded by later findings, which are expressed in the Design Baseline and associated documents.

27753 (DOE/OR/03054—26, pp 223-261) **Environmental assessment of a barge dock facility for the SRC-I demonstration plant.** Apr 1984. NTIS, PC A18/MF A01. Order Number DE84010871. TI84010871

In SRC-I quarterly technical report, April-June 1983.

This report evaluates the environmental effects of transporting construction equipment, feed coal, and SRC products to or from the SRC-I Demonstration Plant by barge, rather than by rail.

Specifically, the impact of constructing a barge dock at the site is assessed. The study lists the anticipated effects of constructing and operating three alternative barge dock designs: (1) a dock limited to unloading of construction equipment; (2) an expanded dock capable of handling feed coal and product transport for the 6000-ton-per-day (tpd) plant; and (3) a dock that can accommodate material handling for a commercial-size 30,000-tpd plant. Overall, the impacts of constructing or operating any of the proposed barge facilities are minimal. Changes to soils, groundwater, surface water, and aquatic and terrestrial biology were analyzed, as well as the effects of noise and increased barge traffic. 21 references, 5 figures, 6 tables.

27754 (DOE/OR/03054—26, pp 263-370) **Geotechnical engineering study.** Apr 1984. NTIS, PC A18/MF A01. Order Number DE84010871. TI84010871

In SRC-I quarterly technical report, April-June 1983.

Preliminary and intermediate geotechnical engineering studies were conducted at the site of the proposed SRC-I Demonstration Plant, in Daviess County, Kentucky. Subsurface conditions at the site were investigated by 12 test borings made in 1977 and by an additional 16 borings made in 1979. Laboratory tests were conducted on samples taken from these borings to evaluate the engineering properties of the soil. Using the field and laboratory data, ATEC developed the following preliminary recommendations to aid in designing foundation and other earth-related components of the plant. 42 figures, 8 tables.

27755 (DOE/OR/03054—26, pp 371-391) **Site liquefaction analyses.** Apr 1984. NTIS, PC A18/MF A01. Order Number DE84010871. TI84010871

In SRC-I quarterly technical report, April-June 1983.

Even though the data presented have been qualified as extremely approximate, they do provide a guide for assessing liquefaction potential at the Newman site. In general, the highest probability of liquefaction occurring exists under normal groundwater conditions. Under these conditions, the instability will be deep and the most likely distress will be in the form of an area subsidence (on the order of 5 in.), with some differential settlement likely. On the other hand, should liquefaction occur during high groundwater levels, the occurrence and magnitude of ground distortion will be considerably greater than for the lower groundwater condition, although the probability of both the earthquake and a major flood occurring simultaneously is extremely remote. Based on these conclusions, the following recommendations are made regarding the liquefaction problem: (1) Because the possibility of a critical earthquake occurring during a major flood is remote, ATEC recommends that only structures presenting a serious threat to public safety in the event of a liquefaction failure be designed for this case. Therefore, subgrade improvement of the near-surface loose granular soil to reduce the liquefaction potential will be required in only very limited areas (if at all). The subgrade should be improved to be safe against an earthquake-induced ground acceleration of 15% of gravity. In addition, the granular soils above the normal groundwater level should be improved to an average N value of 15. (2) ATEC also recommends that liquefaction be considered only under normal groundwater conditions for all other structures. Subgrade improvement for the sole purpose of reducing liquefaction potential should be based on a ground acceleration of 15%. 7 references, 12 figures.

27756 (DOE/OR/03054—26, pp 393-404) **Water intake structure study.** Apr 1984. NTIS, PC A18/MF A01. Order Number DE84010871. TI84010871

In SRC-I quarterly technical report, April-June 1983.

The purpose of this study was to determine the most environmentally and economically desirable water intake structure for the 6000-ton-per-day (tpd) SRC-I Demonstration Plant. Two types of structures were considered: a conventional shoreline structure with a traveling screen and a submerged structure with a wedge-wire screen. The submerged intake method was the least objectionable environmentally, because it has a lower impact and can be modified if any objections arise during permitting. On the other hand, the conventional strucutre is less costly, although various uncertainties must be resolved. At the time the report was completed (1981), Rust recommended the following steps: (1) determine the environmental impact of the conventional structure at the exact plant location; (2) discuss mitigating measures with EPA; (3) obtain competitive bids; (4) proceed with the submerged structure only if environmental factors become the strongest objection; otherwise, proceed with the conventional intake method. 6 references, 2 figures, 2 tables.

27757 (DOE/OR/03054—57) **Subcontracted R and D task summary report: coal, KMAC, and slag physical properties.** Sivasubramanian, R. (International Coal Refining Co., Allentown, PA (USA)). Sep 1983. Contract AC05-78OR03054. 41p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE84011554.

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This report integrates and summarizes common results from three different research programs in the area of gasification technology. Measurements of CO_2-carbon char reactivities, slag viscosities, and heat capacities of several samples of coal, Kerr-McGee ash concentrate (KMAC), and the ashes derived from them are presented and discussed. 6 references, 15 figures, 4 tables.

27758 (DOE/OR/03054—68-Vol.1) **Vapor compression evaporation system design for the SRC-I coal refinery. Vol. 1.** (Resources Conservation Co., Seattle, WA (USA)). Feb 1984. Contract AC05-78OR03054. 33p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE84012978.

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As part of its contract to design, build, and operate the SRC-I Demonstration Plant in cooperation with the U.S. Department of Energy, International Coal Refining Company (ICRC) has evaluated a zero discharge, closed-loop wastewater treatment system for the demonstration plant. This system includes extensive secondary (biotreatment) and tertiary treatment (filtration, carbon adsorption), as well as unit processes directly related to reuse. These processes are softening, reverse osmosis, and vapor compression evaporation and stabilization of zero discharge solid wastes. This report describes the preliminary process design for the vapor compression evaporation area of the zero discharge wastewater system. Three alternate feed streams to the vapor compression evaporation area are discussed. The report includes: preliminary process descriptions, process flow diagrams, utility requirements, layout sizes, major equipment lists, and estimates of operating and capital costs. Volume I of this report is a nonproprietary version that will be available to the public. Volume II contains information designated proprietary data of Resources Conservation Co., the ICRC subcontractor for the vapor compression evaporation area of the SRC-I Demonstration Plant. Volume II is subject to "Limited Rights in Proprietary Data," as set forth in Contract No. DE-AC05-78-ORO-3054 between ICRC and DOE and in Subcontract No. 01-13176 between ICRC and Resources Conservation Co.

27759 (DOE/OR/03054—81) **SRC-I naphtha hydrotreating study non-proprietary version. Final technical report.** Ulowetz, M.A. (UOP, Inc., Des Plaines, IL (USA). Process Div.). Nov 1983. Contract AC05-78OR03054. 257p. NTIS, PC A12/MF A01; 1; GPO Dep. Order Number DE84012746.

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This final report covers pilot plant and engineering work as specifically outlined by the International Coal Refining Company (ICRC) Statement of Work for the Hydrotreating Study Task dated March 17, 1983 and Addendum No. 1 dated June, 1983. The report presents the results of the raw SRC-I naphtha feedstock analysis, first-stage pilot-plant hydrotreating, second-stage hydrotreating parametric studies, the catalyst aging or pilot plant stability study, the engineering process design study for a commercial hydrotreating unit, and consideration of, and comments on, the feasibility of processing an alternative full boiling range (C_4-425°F nominal) SRC-I naphtha feedstock in the commercial unit. The Engineering Process Design Study produced a naphtha hydrotreating unit design that incorporated a two-stage reaction section analogous to the pilot plant processing scheme. Special consideration was given to reactor feed and effluent heat recovery schemes as well as assuring that protection against corrosion from chloride, sulfur and ammonium salts was provided. The major limitation determined from

the process design study was the availability of hydrogen makeup gas. UOP recommends that an additional 20% over the quantity specified by ICRC be made available to assure stable unit operation. 15 figures, 59 tables.

27760 **(DOE/PC/40799—T10) Heteroatom speciation in coal liquefaction via FTIR coupled with liquid chromatography. Quarterly progress report, January 1-March 31, 1984.** Taylor, L.T. (Virginia Polytechnic Inst. and State Univ., Blacksburg (USA)). May 1984. Contract FG22-81PC40799. 27p. NTIS, PC A03/MF A01; GPO Dep. Order Number DE84011813.

Through this study several conclusions can be drawn. First, it is apparent that although maximum infrared signal can be obtained in μ-HPLC-FTIR experiments using the infrared scan taken at the peak maximum, the maximum signal-to-noise is observed by integrating across the peak to +-1.37 σ from the peak maximum. Peaks may be quantitated using either peak height or peak area; in the HPLC-FTIR experiment, the use of peak area methodology results in the best sensitivity. The FTIR has again been shown to be a concentration-dependent detector for chromatography. It is much more beneficial, consequently, to optically modify the infrared beam to fit a suitable chromatographic cell for the μ-HPLC-FTIR experiment than it is to try to force fit the chromatographic system into the existing spectrometric system. Since the concentration profile of a μ-HPLC separation is more closely followed as the detector cell volume decreases, the μ-HPLC-FTIR experiment requires a very small volume flow cell. Although the early treatment of this matter for GC-FTIR implied that the FTIR has some characteistics of a mass-sensitive detector, we have shown that for the μ-HPLC-FTIR experiment, this is not the case. Finally, a multitude of improvements have resulted in enhanced detection limits. 19 references, 2 tables, 7 figures.

27761 **(DOE/PC/50041—36) Utilization of the hydrogen-microautoclave in support of the coal liquefaction process, topical report No. 9. Wilsonville advanced coal liquefaction research and development facility, Wilsonville, Alabama.** (Catalytic, Inc., Wilsonville, AL (USA)). May 1984. Contract AC22-82PC50041. 80p. NTIS, PC A05/MF A01; 1; GPO Dep. Order Number DE84012432.

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This topical report presents data and results obtained from the hydrogen microautoclave. The autoclave has been used to test for the quality of hydrotreater residue product and hydrotreater catalyst activity. Data obtained from Run 242 and the first part of Run 243 is presented in a convenient format and conclusions based upon this data are summarized. Some of the topics discussed in this report are the following: development and description of procedures for the catalyst and hydrotreater residue, the significance of test results and their meaning, and the relationship of test results to process performance. 7 references, 13 tables, 22 figures.

27762 **(DOE/PC/50793—T6) Cooperative investigation by Auburn University and Cities Service Research and Development Company of combined coal and heavy resid processing. Quarterly report, October 15, 1983-January 15, 1984.** Curtis, C.W.; Guin, J.A.; Tarrer, A.R. (Auburn Univ., AL (USA). Coal Conversion Lab.). 1984. Contract FG22-82PC50793. 49p. NTIS, PC A03/MF A01; GPO Dep. Order Number DE84006602.

The objective of this research is to determine the feasibility of using heavy petroleum crudes and residua as solvents in coal liquefaction. Petroleum residuum is a hydrogen-rich material and coal is hydrogen deficient. In coprocessing, the fundamental concept being evaluated is to determine if petroleum residua can transfer hydrogen directly to coal at specified reaction conditions. The reaction parameters for such a transfer must be determined and optimized. Secondly, the idea of modifying the petroleum residua to produce more effective solvents for transferring hydrogen to coal during liquefaction is being evaluated. The goal of the coprocessing is to increase the net yield and improve the quality of liquid product compared to that originally present in the petroleum residuum. The parametric evaluation has shown that optimal conditions for combined processing are: Reaction Tempperature - 425°C; Hydrogen Pressure - above 500 psia initial hydrogen pressure; Time - 90 minutes; and Catalyst - powdered hydrogenation catalyst. Coal conversion and oil production from combined catalytic (powdered) processing compare favorably with that from tetralin with a powdered catalyst. An added benefit of combined processing is the upgrading of the petroleum crude which is obtained during processing. Comparison of the final oil yields to the initial charge shows that combined processing yields a net increase of 23.3% for 90 minute reaction time while tetralin provides a net increase of 17.7% for 30 minutes of reaction. 3 figures, 20 tables.

27763 **(DOE/PC/50795—T1) Coal pyrolysis in flat, opposed jet combustion configurations. Interim technical progress report, September 1, 1982-August 31, 1983.** Wendt, J.O.L. (Arizona Univ., Tucson (USA). Dept. of Chemical Engineering). Nov 1983. Contract FG22-82PC50795. 28p. NTIS, PC A03/MF A01. Order Number DE84002415.

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The objective of this research is to investigate the thermal decomposition of pulverized coal in hot flue gas environments, under high heating rates and at temperatures in excess of 1500°K, using a laminar opposed jet combustion configuration. An understanding of coal particle behavior under rapid heating conditions and within the first 100 ms of the pyrolysis process is important since these early processes play an important role in coal particle ignition, flame stability and trace species evolution in practical combustion systems. These phenomena are also relevant to high temperature gasification processes. Theoretical work has shown that the pulverized coal laminar opposed jet combustion configuration is one dimensional in concentrations, temperature, particle density and particle temperature and that it can be modeled to whatever complexity is appropriate. Although particles do not follow the gas streamlines, their trajectories can be described precisely, and thus their life histories prior to sampling can be determined. The experimental system has been constructed and some preliminary data has been obtained. Optimum operating conditions for this apparatus have been determined and coal pyrolysis conditions in reducing environments at temperatures in excess of 1700°K and at heating rates of 10^4K/sec have been achieved.

27764 **(DOE/PC/50799—T3) Enhanced coal liquefaction by hydropyrolysis in supercritical fluids. Quarterly report, January-March 1984.** Paulaitis, M.E.; Klein, M.T.; Stiles, A.B. (Delaware Univ., Newark (USA). Dept. of Chemical Engineering). 1984. Contract FG22-82PC50799. 15p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE84011894.

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The product spectra observed for benzyl phenyl amine (BPA) pyrolysis in supercritical water is similar to that found for neat pyrolysis. Major products of neat pyrolysis are toluene and aniline. Pyrolysis in supercritical water shows benzyl alcohol as a primary product and decreased yields of toluene relative to neat pyrolysis. The product spectra observed for BPA pyrolysis in supercritical methanol at 386°C is also similar to that obtained for neat pyrolysis. The yield of toluene is essentially unchanged in the npresence of methanol, but the yield of aniline is greatly reduced. The benzyl alcohol yield is comparable to that observed for pyrolysis in water at the same temperature. Phase equilibria at elevated temperatures and pressures for model coal compounds in supercritical methanol have also been investigated during this reporting period. Gas-liquid equilibrium tie lines for binary mixtures of 1-naphthol with methanol have been measured at temperatures from approximately 250° to 300°C and at pressures up to 2000 psia. The experimental results are given in Table II and are depicted in Figure 9. These data can be compared to experimental results given in previous quarterly reports for binary mixtures of 1-methylnaphthalene (1MN) with methanol. The phase envelopes for both binary mixtures are quite similar, and indicate that supercritical methanol has a high solvent capacity for these aromatic compounds at elevated temperatures and pressures. The effect of the substituent -OH or -CH3 group on the equilibrium phase behavior appears to be relatively small, and thus thermodynamic models for more complex mixtures might group such constituents as characterized by the two-ring aromatic nature of these compounds. 9 figures, 2 tables.

27765 **(DOE/PC/53019—T1) Measurement of the physical structure of coal liquids via low-angle x-ray scattering. Final technical report, June 2, 1982-June 1, 1983.** Schmidt, P.W. (Missouri Univ., Columbia (USA). Dept. of Physics). 15 Dec 1983. Contract AC22-82PC53019. 20p. NTIS, PC A02/MF A01; GPO Dep. Order Number DE84004737.

Heavy direct coal liquefaction products are known to exhibit rapidly increasing viscosities upon prolonged exposure to oxygen. Small angle x-ray scattering has been used to monitor changes in the colloidal structure of a coal liquid subjected to accelerated aging under an oxygen atmosphere for a total period of eight weeks. The data are consistent with an agglomeration model for the formation of large colloidal size scattering centers which are partially responsible for the rapidly increasing viscosity of the coal liquid. 21 references, 2 figures.

27766 **(DOE/PC/60047—T3) Advanced research for the characterization of hydrogen donor solvents in two-stage liquefaction. Quarterly report, January 1-March 31, 1984.** Coghill, D.R.; Potts, J.D. (Cities Service Research and Development Co., Tulsa, OK (USA)). Apr 1984. Contract AC22-83PC60047. 48p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE84010316.

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Two solvents with an intermediate hydrogen content (about 7.5%) and different boiling point distributions were prepared and used for Subtask 3.1 in order to determine the effect which the different boiling point distributions would have on SCT coal liquefaction. These two solvents were an 85/15 weight percent blend of Lummus hydrogenated KC-Oil and SCT extract from Illinois No. 6 coal (called Solvent B) and a 42.5/40/17.5 weight percent blend of raw KC-Oil, Xytel hydrogenated KC-Oil and Illinois No. 6 SCT extract (called Solvent C). Two eleven-run matrices of microautoclave runs were completed using Illinois No. 6 coal and Solvents B and C. Solvent B is capable of achieving 90% conversion of Illinois No. 6 coal at a wide range of SCT conditions. Increasing the residence time from 2 to 10 minutes allows the use of lower temperatures (803°F instead of 850°F) to achieve 90% conversion. Once a coal conversion of 90% is reached, increasing temperature and time reduces the net product preasphaltenes and asphaltenes and increases the net product oil. Hydrogen consumption and C_1 to C_4 gas make also increase with temperature and time. Pressure variations from 500 to 2500 psig have no effect on coal conversion with Solvent B. Product quality decreases with lower pressure by resulting in slightly lower net asphaltenes and slightly higher net preasphaltenes, lower feed desulfurization and lower liquid product H/C ratios. Hydrogen consumption is also slightly reduced. Solvent C is also capable of achieving 90% conversion of Illinois No. 6 coal but at a narrower range of SCT conditions than the range observed with Solvent B. Varying the residence time has very little effect on coal conversion with Solvent C so the temperature range at which 90% conversion can be obtained is smaller (822°F to 850°F instead of 803°F to 850°F). As with Solvent B, increasing temperature and time reduced net preasphaltenes and net asphaltenes and increased net oil.

27767 **(DOE/PC/60784—T1) Rate of coal hydroliquefaction correlation to coal structure. Quarterly progress report, October-December 1983.** Baldwin, R.M. (Colorado School of Mines, Golden (USA). Dept. of Chemical and Petroleum Refining Engineering). Jan 1984. Contract FG22-83PC60784. 33p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE84012528.

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A suite of coals from the Exxon Sample Library is being liquefied in a batch stirred autoclave reactor. The rate of conversion of coal to pentane-solubles, benzene-solubles, and THF-solubles is being determined for each coal, and global rate models for each lumped group are being derived. Rate and extent of conversion of coal are being correlated to physical and chemical parameters of the parent coal. This report presents the results for liquefaction of the first suite of coals from the Exxon collection, and preliminary correlations based on simple lumped-parameter kinetic models. 5 references, 12 figures, 4 tables.

27768 **(DOE/PC/60796—3) Reactions governing coal solubilization. Third quarterly progress report, January 15, 1984 to April 15, 1984.** Stock, L.M.; Choi, C.; Mallya, N. (Chicago Univ., IL (USA). Dept. of Chemistry). May 1984. Contract FG22-83PC60796. 16p. NTIS, PC A02/MF A01; GPO Dep. Order Number DE84012383.

The influences of a selected group of coals and maceral concentrates on the cleavage reaction of 1,3-diphenylpropane have been investigated. Some differences in the ability of different macerals to promote the decomposition of 1,3-diphenylpropane were observed. The order of reactivity for the samples is investigated in this quarter suggest that exinites > vitrinites > inertinites in their capacity to enhance the decomposition of this hydrocarbon. Work during this quarter concerned obtaining 89% C coals from various locations. Also coals of other ranks were obtained for comparative studies. The samples were ground. Comparison of elemental analysis provided by Commercial Testing and Engineering Co. and PSOC data base show some differences which probably reflect real variations in the composition of the different samples of these coals. The solubility data obtained for some of the samples corroborate with the trends described in the literature. 14 references.

27769 **(EPRI-AP—3440) Pilot plant evaluation of Exxon Donor Solvent residue for the Texaco Coal Gasification Process. Final report.** Robin, A.M.; Child, C.A. (Texaco, Inc., South El Monte, CA (USA). Montebello Research Lab.). May 1984. 52p. EPRI-RRC, Box 50490, Palo Alto, CA 94303. Order Number DE84920359.

The objectives of this project were to (1) gain experience with Exxon Donor Solvent (EDS) Illinois No. 6 coal liquefaction residue in the 15-t/d Montebello gasifier and (2) identify satisfactory operating conditions for the 200-t/d TVA gasifier. Conclusions are as follows: (1) EDS residue in water slurry form is an excellent feedstock for the Texaco Coal Gasification Process. The optimum operation in the MRL pilot plant was achieved at an oxygen-to-residue feed ratio of about 0.87 lb/lb. Operating at this ratio resulted in a high carbon conversion and the production of 28 SCF of $CO+H_2$ per pound of residue feed. (2) EDS residue will make an excellent feed stock for the coal gasification demonstration plant at TVA. Based upon the work described in this report, recommendations for the TVA TCGP demonstration plant test run on this feedstock have been developed and provided to the appropriate parties. 6 figures, 8 tables.

27770 **(EPRI-AP—3486-Vol.1) Cost and performance for commercial applications of Texaco-based gasification/combined-cycle plants. Volume 1. Summary and discussion of results. Final report.** Matchak, T.A.; Rao, A.D.; Ramanathan, V.; Sander, M.T. (Fluor Engineers, Inc., Irvine, CA (USA)). Apr 1984. 103p. EPRI-RRC, Box 50490, Palo Alto, CA 94303. Order Number DE84920367.

This report presents the results of a study conducted by Fluor Engineers, Inc. for EPRI to develop a current estimate of the performance and cost of a mature, Texaco-based integrated coal gasification-combined-cycle (IGCC) power plant. Both Texaco, Inc. and the General Electric Company were major participants during the entire course of the effort. Consequently, all designs presented in this study use the most recent data available from Texaco's ongoing international coal gasification development program and General Electric's continuing gas turbine development efforts. Three basic IGCC plant configurations were studied. The major difference in these configurations is the level of heat recovery from the gas immediately downstream of the gasifier. A major conclusion of this comprehensive study is that Texaco-based IGCC power plants have the potential to be 10% more efficient than conventional subcritical coal-fired steam plants designed to comply with current federal environmental regulations when firing Illinois No. 6 coal. Furthermore, the IGCC systems have the potential to be capital cost competitive with conventional coal-fired steam plants while providing up to 15% reductions in levelized costs of electricity as well as substantial reductions in both SO/sub x/ and NO/sub x/ emissions. The report has been prepared in two volumes. Volume 1 provides an overall summary and discussion of the major results. Volume 2 includes the design, performance, cost, and

other backup details that were used in arriving at the results and conclusions presented in Volume 1. 19 figures, 9 tables.

27771 **(EPRI-AP—3486-Vol.2) Cost and performance for commercial applications of Texaco-based gasification-combined-cycle plants. Volume 2. Design details. Final report.** Matchak, T.A.; Rao, A.D.; Ramanathan, V.; Sander, M.T. (Fluor Engineers, Inc., Irvine, CA (USA)). Apr 1984. 343p. EPRI-RRC, Box 50490, Palo Alto, CA 94303. Order Number DE84920340.

This report presents the results of a study conducted by Fluor Engineers, Inc. for EPRI to develop a current estimate of the performance and cost of a mature, Texaco-based integrated coal gasification-combined-cycle (IGCC) power plant. Both Texaco, Inc. and the General Electric Company were major participants during the entire course of the effort. Consequently, all designs presented in this study use the most recent data available from Texaco's ongoing international coal gasification development program and General Electric's continuing gas turbine development efforts. Three basic IGCC plant configurations were studied. The major difference in these configurations is the level of heat recovery from the gas immediately downstream of the gasifier. A major conclusion of this comprehensive study is that Texaco-based IGCC power plants have the potential to be 10% more efficient than conventional subcritical coal-fired steam plants designed to comply with current federal environmental regulations when firing Illinois No. 6 coal. Furthermore, the IGCC systems have the potential to be capital cost competitive with conventional coal-fired steam plants while providing up to 15% reductions in levelized costs of electricity as well as substantial reductions in both SO/sub x/ and NO/sub x/ emissions. The report has been prepared in two volumes. Volume 1 provides an overall summary and discussion of the major results. Volume 2 includes the design, performance, cost, and other backup details that were used in arriving at the results and conclusions presented in Volume 1.

27772 **(IS-M—477) Oxydesulfurization of coal: further studies of oxy-alkalinolysis.** Venier, C.G.; Singh, M.M.; Aida, T.; Squires, T.G. (Ames Lab., IA (USA)). 8 Apr 1984. Contract W-7405-ENG-82. 8p. (CONF-840415—23). NTIS, PC A02/MF A01; GPO Dep. Order Number DE84012839.

From 187. national meeting of the American Chemical Society; St. Louis, MO, USA (8 Apr 1984).

This study shows that preoxidation of coal samples by bromine markedly increases the efficiency of sulfur removal by molten caustic treatment. Under conditions which give a 65% sulfur reduction with KOH fusion alone, a preoxidized sample can be 94% desulfurized. That some hydrogen substitution and dehydrogenation processes are faster than sulfur oxidation has been demonstrated. The substitution reactions are probably phenol brominations and the replacement of active aliphatic hydrogen by bromine. The dehydrogenation reactions probably involve oxidation of easily oxidized carbon-carbon and carbon-oxygen bond systems. 10 references, 3 figures, 4 tables.

27773 **(NP—4770262) Effect of thermal pretreatment of coal on the process of coking.** Pollert, G. (Technische Univ. Clausthal, Clausthal-Zellerfeld (Germany, F.R.). Fakultaet fuer Bergbau, Huettenwesen und Maschinenwesen). 5 Jul 1982. 100p. (In German). NTIS (US Sales Only), PC A06/MF A01. Order Number DE84770262.

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The aim of this investigation was the determination of the effect of thermal pretreatment of coal or the process of coking. The effect of the preheating on different coals, the extraction of untreated and pretreated coals and the effect of pretreatment with water were studied in laboratory scale. Thereafter coking experiments were carried out in an semi-industrial apparatus. It is found that the reason for the quality improvement, is due to the absence of vaporizing of water in uncoked portion, the formation of a stronger plastic boundary, which serve as a passage for the gases produced on both side of the plastic zone.

27774 **(NP—4770276) Gasification of black coal with air-steam mixtures in fixed bed under pressure with a view to underground gasification.** Ropertz, G.H. (Technische Hochschule Aachen (Germany, F.R.). Fakultaet fuer Bergbau und Huettenwesen). 28 Jul 1982. 139p. (In German). NTIS (US Sales Only), PC A07/MF A01. Order Number DE84770276.

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The aim of this study was the investigation of the gasification behaviour of black coal with air-steam mixtures in fixed bed in regard to in-situ gasification of deep lying seams under pressure. In order to understand the effect of the offered steam to air ratio or the quality of the product gas, the calorific value, autotherm mode of operation and reaction kinetic, isothermal gasification experiments are carried out with air-steam and oxygen enriched air-steam mixtures in small autoclaves under a pressure of 10 bar and at temperatures of between 900°C and 1000°C. The investigations showed that, by an underground gasification process a gasification efficiency of maximal 0,7-0,8 can be obtained.

27775 **(ORNL/Sub—81/24707/3) Coal Liquefaction Technology Assessment. Final report, Phase II Koppers gasification.** (Fluor Engineers and Constructors, Inc., Houston, TX (USA)). Mar 1981. Contract AC05-84OR21400. 423p. NTIS, PC A18/MF A01; 1; GPO Dep. Order Number DE84009529.

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In Phase II of the Coal Liquefaction Technology Assessment Study, conceptual designs and plant costs were prepared for four gasification plant cases: Case TXW - Texaco gasifiers - Wyoming Wyodak coal; case TXE - Texaco gasifiers - Illinois 6 coal; case KW - Koppers gasifiers - Wyoming Wyodak coal; and case KE - Koppers gasifiers - Illinois 6 coal. In each case, unleaded gasoline via the fixed-bed Mobil MTG process was the primary product. The plant costs and efficiencies reported in the Fluor Phase II final reports indicated the relative differences between the gasification processes and between eastern and western coals/sites. Optimization of the plant configuration is possible for each study case which may yield a somewhat higher overall efficiency and somewhat lower plant cost. We would not, however, expect the relative economics of the cases to change substantially. Following completion of the Phase II study work, UCC-ND suggested several modifications to the conceptual design of the Koppers cases which were felt would raise the plant efficiencies and lower the overall plant costs. The alternate designs and costs are discussed in this addendum. UCC-ND also felt additional clarification would be beneficial regarding the designs used in the Phase II reports. That clarification is also presented in this addendum.

27776 **(PB—84-159243) Evaluation and demonstration of the chemically active fluid bed. Final report May 75-Jul 81.** Sommer, R.E.; Werner, A.S.; Kowszun, Z. (GCA Corp., Chapel Hill, NC (USA). GCA Technology Div.). Feb 1984. 222p. NTIS, PC A10/MF A01.

The report gives results of the operation of a 17-MW Chemically Active Fluid Bed (CAFB) demonstration unit, retrofitted to a natural gas boiler. The CAFB process gasifies high-sulfur, high-metals-content liquid and solid fuels. Residual oil, lignite, and bituminous coal were gasified separately or together between November 1979 and June 1981. Design and operational areas where upgrading would be beneficial were identified. Continuous monitors were used to measure boiler flue gas emissions of SO2, NOx, CO, oxygen, CO2, and opacity. Periodic manual emission tests were conducted for particulate, SO2, and NOx, using EPA reference methods. Emissions of these three criteria pollutants were generally lower than New Source Performance Standards for utility boilers, although occasionally excessive particulate and SO2 emissions were observed. NOx emissions were consistently lower than those from natural gas combustion. Results of detailed chemical analyses and biological assays are reported.

27777 **(PB—84-159573) Fluidized-bed gasification of peat, lignite, subbituminous, and pretreated bituminous coal. Final report Aug 76-Aug 83.** Purdy, M.J.; Felder, R.M.; Ferrel, J.K. (North Carolina State Univ., Raleigh (USA). Dept. of Chemical Engineering). Feb 1984. 102p. NTIS, PC A06/MF A01.

The report summarizes and compares results obtained from gasifying four different feedstocks in a pilot-scale fluidized-bed gasifier. Effects of operating variables (e.g., temperature, steam/carbon feed ratio, bed height, and feed rate) on carbon conversion and gas production are described. Gas compositions, expressed as mole percentages on a dry N2-free basis, showed only small differences, except for sulfur gases. No correlation of wastewater species production rates with reactor operating conditions was observed. Tar production rate was greatest for a New Mexico subbituminous coal. A coastal peat and a Texas lignite gave similar tar production rates.

27778 **(PNL—4960) Chemical analysis and biological testing of materials from the EDS coal liquefaction process: a status report.** Later, D.W.; Pelroy, R.A.; Wilson, B.W. (Pacific Northwest Lab., Richland, WA (USA)). May 1984. Contract AC06-76RL01830. 169p. NTIS, PC A08/MF A01; 1; GPO Dep. Order Number DE84012382.

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Representative process materials were obtained from the EDS pilot plant for chemical and biological analyses. These materials were characterized for biological activity and chemical composition using a microbial mutagenicity assay and chromatographic and mass spectrometric analytical techniques. The two highest boiling distillation cuts, as well as process solvent (PS) obtained from the bottoms recycle mode operation, were tested for initiation of mouse skin tumorigenicity. All three materials were active; the crude 800°+ F cut was substantially more potent than the crude bottoms recycle PS or 750 to 800°F distillate cut. Results from chemical analyses showed the EDS materials, in general, to be more highly alkylated and have higher hydroaromatic content than analogous SRC II process materials (no in-line process hydrogenation) used for comparison. In the microbial mutagenicity assays the N-PAC fractions showed greater activity than did the aliphatic hydrocarbon, hydroxy-PAH, or PAH fractions, although mutagenicity was detected in certain PAH fractions by a modified version of the standard microbial mutagenicity assay. Mutagenic activities for the EDS materials were lower, overall, than those for the corresponding materials from the SRC II process. The EDS materials produced under different operational modes had distinguishable differences in both their chemical constituency and biological activity. The primary differences between the EDS materials studied here and their SRC II counterparts used for comparison are most likely attributable to the incorporation of catalytic hydrogenation in the EDS process. 27 references, 28 figures, 27 tables.

27779 **(UCRL—53508) High-angle drilling for the Centralia Partial-Seam Crip Test.** Thompson, D.S. (Lawrence Livermore National Lab., CA (USA)). 7 Feb 1984. Contract W-7405-ENG-48. 31p. NTIS, PC A03/MF A01; GPO Dep. Order Number DE84012149.

The Centralia Partial-Seam CRIP Test, an underground coal gasification experiment at a coal strip mine in Washington State, required the drilling of two long slanted holes. Each was to be about 900 ft long and angled down some 13° from the horizontal, the approximate dip angle of the coal seam. These holes were to begin at the surface, where the coal seam outcropped at a near-vertical excavation face in the open mine. The holes were to be started at points on the surface several hundred feet apart and drilled accurately enough to end up at a predetermined point in the coal seam, some 900 ft away, where they were to intersect each other and be intersected by a third hole drilled down vertically from the surface above the seam. Two attempts to drill the first slant hole failed, and a third attempt was required before it was successfully completed. The second slant hole was drilled successfully on the first attempt, benefiting from the lessons learned in trying to drill the first hole. The vertical hole from the surface intersected the slant injection well, as desired. This report describes the drilling equipment and techniques, gives details of the drilling results, and discusses the problems encountered and the solutions that were developed. Documentation of experience in high-angle slant drilling is valuable, because such drilling may have wide applications in new techniques for natural-resource recovery. 1 references, 8 figures, 4 tables.

27780 **(UCRL—90239) Transient, moving-front phenomens in a multi-phase medium.** Kang, S.W. (Lawrence Livermore National Lab., CA (USA)). Jan 1984. Contract W-7405-ENG-48. 12p. (CONF-840720—2). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE84011551.

From International conference on numerical methods for transient and coupled problems; Venice, Italy (9 Jul 1984).

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The nonlinear partial differential equations describing transient moving-front phenomena in a multiphase medium have been solved by application of an implicit, finite-difference numerical integration method. Solutions were obtained for phase fronts moving in a pyrolyzing solid block. The results display interesting physical processes taking place inside the polyphase, heat-conducting medium. The principal motivation for the present work stems from the need to develop an efficient numerical analysis of physicochemical phenomena inside a multi-phase medium. Specifically, we are interested in characterizing transient fronts moving simultaneously in a medium; precipitous property change take place across these fronts. Such situations occur, for example, when we impose a high external heat flux on a solid block of wet coal. The heat flux vaporizes the liquid water inside the coal and proceeds inward from the surface, creating a discontinuity (phase front) in the coal. For sufficiently high heat flux pyrolysis of coal also takes place; the pyrolysis front now moves inward as well as the dry front generated earlier due to the water-vaporization process. Pyrolysis and drying processes of coal are just one example of various simultaneous moving fronts occurring in nature. Following development of the numerical analysis and the solution technique we will apply the method to the case of transient moving-front phenomena in a multiphase medium.

0105 By-products

27781 **Analysis of industrial applicability of low-Btu gas.** Rebello, W.J.; Phipps, H.R. Jr.; Canete, D.W.; Trescott, E.B.; Ludwig, L.; Crowell, J.J. *Industrial Heating (Pittsburgh);* **46**: 6-7(Nov 1979).

A study of the potential of using low-Btu gas in industrial applications, conducted by consultant W.J. Rebello along with Systems Consultants, Inc., and the US Department of Energy, reached the following conclusion. 1) Substituting low-Btu gas for current fuels could save 44% of industrial direct-heat and process-steam energy and 27% of total industrial energy consumption. 2) Low-Btu gas could replace almost 3.3 quads of current natural gas consumption. 3) Energy consumption in the chemical, primary metal, and petroleum industries would benefit the most by the substitution of low-Btu gas for current fuels. 4) The industrial states of Pennsylvania, Ohio, Illinois, and Indiana have a high market potential for low-Btu gas; all four states have large supplies of coal available for low-Btu gasification. 5) Texas and Louisiana have the highest identified market potential (29% or 1.5 quads) for low Btu gas, but their past production of coal has been low. 6) Further study will identify the total market for low-Btu gas. A full market study would include an examination of economics, multiple plant use of a single gasifier, the potential for gasification by smaller size plants, and projections of future industrial potential.

0106 Properties

REFER ALSO TO CITATION(S) 27760, 27773, 27890, 28893

27782 **(CONF-840408—12) Instrumental neutron activation analysis in the measurement of trace element distribution at two coal conversion plants.** Roseberry, L.M.; Dyer, F.F. (Oak Ridge National Lab., TN (USA)). 1984. Contract AC05-84OR21400. 3p. NTIS, PC A02/MF A01; GPO Dep. Order Number DE84011466.

From 5. international conference on nuclear methods in environmental and energy research; Mayaguez, Puerto Rico (2 Apr 1984).

Instrumental neutron activation analysis was used to study the elemental concentration in the complex materials produced by the H-Coal process and the low Btu gasification process at the University of Minnesota at Duluth (UMD). Trace element distribution in feed coal, ash, cyclone fines, and ESP tar were determined in the UMD gasifier. Trace element distribution in feed coal and vacuum bottoms were determined for the H-Coal liquefaction pilot plant. The results were compared. Elements measured were: Al, Sb, As, Ba, Br, Ca, Ce, Cs, Cl, Cr, Co, Eu, Ga, Hf, Fe, La, Mg, Mn, Mo, K, Rb, Sm, Sc, Se, Na, Ta, Th, Ti, W, U, V, Yb, and Zn. 11 references, 1 table (DMC)

27783 **(DOE/PC/30223—13) Petrographic characterization of Kentucky coals. Final report. Part V. Pyrite size/form/microlithotype distribution in western Kentucky prepared coals and in channel samples from western Kentucky and western Pennsylvania.** Frankie, K.A.; Hower, J.C. (Kentucky Univ., Lexington (USA). Dept. of Geology). 1983. Contract FG22-80PC30223. 247p. NTIS, PC A11/MF A01; 1; GPO Dep. Order Number DE84010698.

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Pyrite and marcasite distribution has been characterized in several western Kentucky coals, western Pennsylvania coals, and coals from western Kentucky preparation plants using three parameters of size, morphology, and microlithotype association. A classification system was developed to provide a consistent method for recording different pyrite/marcasite types. Sulfides were microscopically measured and placed in one of six size divisions (<5, 5 to 10, 10 to 40, 40 to 75, 75 to 100, or $>150\mu m$) rather than absolute size. Five categories (euhedral, framboidal, dendritic, massive, or cleat) describe pyrite/marcasite morphology. The third parameter identifies the microlithotype (vitrite, clarite, inertite, liptite, durite, vitrinertite, trimacerite, or carbominerite) in which the pyrite occurs (not including the measured sulfide). Carbominerite is a mineral/organic association dominated by mineral matter. The percentage of each variable represents the total number of counts per sample and not the volume of pyrite. Throughout the studies, both sulfides are collectively referred to as pyrite unless otherwise specified. This paper describes the different studies which were undertaken to test the usefulness of this pyrite classification system. Systematic trends in pyrite variability were determined for the Springfield coal and Herrin of western Kentucky. Pyrite characterization of the Lower Kittanning coal from western Pennsylvania shows that certain pyrite morphologies can be an expression of the environments deposition of coal bodies. Studies of western Kentucky prepared coals demonstrate that pyrite characterization apparently can provide a method for predicting pyrite behavior and the extent of pyrite removal for specific coals. 77 references, 15 figures, 19 tables.

27784 **(DOE/PC/30252—T12) Hydrogen bonding in asphaltenes and coal. Final report.** Li, N.C. (Duquesne Univ., Pittsburgh, PA (USA). Dept. of Chemistry). May 1984. Contract AC22-80PC30252. 13p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE84011624.

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The objective of this project is to investigate the nature and strength of hydrogen bonding and other molecular interreactions in coal liquids and their fractions. Determinations are made of the molecular interactions involving the preasphaltene, asphaltene and oil fractions, together with their separated fractions, obtained from coal liquids after hydroprocessing under different processing conditions and accelerated aging. NMR, IR, GC/MS, calorimetric, GPC, viscosity methods are used to determine structural changes caused by upgrading and aging of coal liquids. Summary of activities are presented for the following: (1) 600-MHz proton magnetic resonance study of coal-derived liquids; (2) aging of SRC liquids; (3) analysis of upgraded SRC liquid products; (4) oxidation degradation of coal liquids; (5) aging of SRC II middle distillates from Illinois No. 6 coal; (6) gas chromatographic investigation of the retention characteristics of underivatized phenols on Superox-20M; (7) effects of various phenol additives on viscosity of SRC blends; (8) GLC meeting for separation of complex mixtures of phenols from coal liquefaction products; (9) upgraded SRC-II and H-coal liquid products; (10) light scattering study of aging of coal liquids; (11) evidence of phenolic oxidation coupling in coal liquids; and (12) hydrogen bonding study of the acid and base fractions separated from SRC II middle distillates.

27785 **(DOE/PC/40783—T14) Instrumental methods of analysis of sulfur compounds in synfuel process streams. Quarterly technical progress report, January-March 1984.** Jordan, J.; Sexton, E.; Talbott, J.; Yakupkovic, J. (Pennsylvania State Univ., University Park (USA). Dept. of Chemistry). Apr 1984. Contract FG22-81PC40783. 17p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE84012029.

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Task 1. Methods development for the speciation of the polysulfides. Work on this task has been completed in December 1983 and reported accordingly in DOE/PC/40783-T13. Task 2. Methods development for the speciation of dithionite and polythionates. Work is in progress on the polarography of the polythionates. Results will be presented in a forthcoming Quarterly Report. Task 3. Total accounting of the sulfur balance in representative samples of synfuel process streams. Two aqueous samples emanating from different stages of the Lummus Process were analyzed. As expected, total sulfur content was low, viz., 0.006 M and 0.001 M. Concentrations of sulfidic sulfur, polysulfidic sulfur, thiosulfate, sulfite, trithionate, tetrathionate, and pentathionate were less than 0.001 M each. 5 references, 3 tables.

27786 **(DOE/PC/60785—3) Organic oxygen characterization of coal and coal liquids. Quarterly progress report, February-April 1984.** Ehmann, W.D.; Hamrin, C.E.; Koppenaal, D.W.; Tian, W.Z.; Jones, W.; Prasad, M.N. (Kentucky Univ., Lexington (USA)). May 1984. Contract FG22-83PC60785. 26p. NTIS, PC A03/MF A01; GPO Dep. Order Number DE84012743.

Oxygen contents of 21 Kentucky and 14 Penn State Data Bank (PSOC) coals have been determined by fast neutron activation analysis (FNAA). All analyses were done with freeze-dried coals. Oxygen contents of low temperature ashes and acid demineralized (AD) samples from the PSOC coals were also measured. FNAA oxygen analyses on AD samples yield organic oxygen contents directly, while total oxygen minus LTA oxygen by FNAA provides an independent organic oxygen value. A pyrolysis-coulometry method of oxygen determination was also applied to the AD and whole PSOC coals. All these methods yield results for organic oxygen which are generally in good agreement. Results obtained by ASTM and Given's oxygen-by-difference methods based on ultimate analyses agree in many, but not all cases. Several equations were developed to express the correlation between inorganic oxygen and silicon on a freeze-dried, whole coal (wc) basis. The best fits to experimental data were obtained with quadratic and log-log equations. The preliminary quadratic equation developed is: (Dinorg)/sub wc/ = 0.835 + 2.959(Si/sub wc/) - 0.0654(Si/sub wc/)^2. This equation partially compensates for high contents of quartz and/or non-silica oxygen minerals (e.g. carbonates and sulfates) which deviate significantly from clay mineral O/Si stoichiometry. Only 3 out of the 35 coal samples analyzed deviated appreciably from the above relationship. The mineralogy of the samples is currently being studied and a detailed interpretation of the data will be presented later. 29 references, 4 figures, 12 tables.

27787 **(DOE/PC/60807—3) Supercritical fluid chromatography/supersonic jet spectroscopy. Progress report, February 1-April 30, 1984.** Lee, M.L.; Goates, S.R. (Brigham Young Univ., Provo, UT (USA). Dept. of Chemistry). May 1984. Contract FG22-83PC60807. 20p. NTIS, PC A02/MF A01; GPO Dep. Order Number DE84012124.

Preliminary testing of the supercritical fluid extraction/fractionation equipment has been started. Restrictor dimensions necessary for a wide range of flow rates and pressures have been calculated. Operation of the mass spectrometer in the chemical ionization and electron impact modes when coupled to the supercritical fluid chromatograph was investigated. The best performance (low background noise and increased sensitivity for high molecular weight compounds) was obtained under chemical ionization conditions.

Two vacuum stillbottoms samples were analyzed by supercritical fluid chromatography on an n-octylpolysiloxane stationary phase and with fluorescence detection. Construction and preliminary testing of the supersonic jet detection system is well underway. 3 references, 7 figures.

27788 **(DOE/PETC/TR—84/7) Analyses of tipple and delivered samples of coal collected during fiscal years 1982 and 1983.** Welsh, R.A. (USDOE Pittsburgh Energy Technology Center, PA). Apr 1984. 30p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE84012132.

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This Department of Energy (DOE) publication updates a series of Topical Reports (formerly Reports of Investigation) on the quality of coal purchases under specifications for government use. Listed in alphabetical order by state, county, town, and mine are analytical data on the composition and quality of tipple and delivered samples of coal collected during the fiscal years 1982 and 1983. Tipple samples were collected by commercial laboratories under contract in accordance with instructions given by the Coal Sampling and Inspection Office (CSIO). The delivered samples were collected at destination by installation personnel, and all samples were analyzed under the supervision of the DOE Coal Analysis Laboratory located in the Pittsburgh Energy Technology Center, Pittsburgh, Pennsylvania. 5 references, 1 table.

27789 **(EPRI-CS—3421) Method for predicting the effective volume resistivity of sodium-depleted fly ash layers in hot-side electrostatic precipitators. Final report.** Bickelhaupt, R.E. (Southern Research Inst., Birmingham, AL (USA)). Mar 1984. 54p. Electric Power Research Inst., Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number DE84920346.

Research has been conducted to develop a technique for predicting the effective volume resistivity of a fly ash layer exposed to circumstances leading to a hot-side precipitator problem known as sodium depletion. Eight fly ashes, representing the major portion of US coals, were evaluated by subjecting 0.5-cm ash layers to a continuously applied voltage gradient of 4 kV/cm for periods of time up to 35 days at a temperature of 350°C (662°F). Resistivity was determined at 350°C (662°F) before the test started and after the long period of applied voltage used to create the sodium-depleted situation. In this condition, resistivity was also determined at 280°C (536°F) for an average electric field intensity of 4 kV/cm and immediately prior to breakdown. This experimental method can be used with any ash sample to estimate resistivity in a sodium-depleted condition. But in addition, a correlation resulting from these resistivity data has been developed. This correlation is combined with an existing technique for predicting resistivity to produce a method for calculating the expected ash layer resistivity after sodium depletion has occurred. This report contains a manual method and a computer program for making this calculation in the temperature range for hot-side precipitation.

27790 **(PB—84-159029) Application of a spray deposition method for reversed phase liquid chromatography-mass spectrometry. Final report.** Thurston, A.D. Jr. (Environmental Protection Agency, Athens, GA (USA). Environmental Research Lab.). Feb 1984. 18p. (EPA—600/4-84-011). NTIS, PC A02/MF A01.

Four coal gasification wastewater samples were analyzed for nonvolatile and polar organics by liquid chromatography-mass spectrometry (LC/MS). Samples were separated on a reverse phase liquid chromatographic column using an aqueous solvent as the eluant. A special spray deposition device was constructed to spray the LC effluent as an aerosol on a Finnigan moving belt LC/MS interface. The evaporated solute on the belt was fed directly to an MS for spectral analysis. In addition to several common organics such as phenol, guaiacol, methyl and dimethyl phenols, seven polar compounds were found, and the mass spectrum of each of these was obtained. They could not be identified, however, using available literature or data bases. The LC aerosol deposition device constructed for the study shows good potential for introducing aqueous eluants on a moving belt LC/MS interface.

27791 **(PNL-SA—11745) Analytical and chromatographic methods for the determination of cyano polycyclic aromatic hydrocarbons in coal-derived materials.** Later, D.W.; Barraclough, S.A.; Lucke, R.B.; Pelroy, R.A.; Stoker, P.; Booth, G.M. (Pacific Northwest Lab., Richland, WA (USA)). Jan 1984. Contract AC06-76RL01830. 16p. (CONF-8310179—9). NTIS, PC A02/MF A01; GPO Dep. Order Number DE84011875.

From 8. international symposium on polynuclear aromatic hydrocarbons; Columbus, OH, USA (26 Oct 1983).

An adsorption chromatographic method has been described for the isolation of cyano-polycyclic aromatic hydrocarbons (PAH) from the PAH and other N-PAC species found in complex matrices. The utility of these methods has been demonstrated by the separation and detailed characterization of the cyano-PAH in a carbon black extract and a coal-derived gasifier medium oil. Results from microbial mutagenicity and aquatic toxicity assays on four 2- and 3-ring cyano-PAH have also been reported. In general, comparatively low levels of mutagenicity and toxicity were observed for the cyano-PAH isomers tested. 23 references, 5 figures, 3 tables.

27792 **Chemical analysis of coal by energy dispersive x-ray fluorescence utilizing artificial standards.** Wheeler, B.D. (EG & G ORTEC Oak Ridge, TN 37830). *Advances in X-Ray Analysis;* **26**: 457-466(1982). (CONF-820861—).

From 31. annual Denver X-ray conference; Denver, CO, USA (3 Aug 1982).

This chapter describes the use of x-ray fluorescence utilizing the powder method to make accurate determinations of the elemental composition of coal. It reports results of an analysis using an EG & G ORTEC 6110 Energy Dispersive X-ray Spectrometer. It explains that since coal standards are not particularly stable with time and some compositional ranges are not adequately covered, utilization of artificial standards and calculating the variations in the 2 types of matrices offers a convenient method of calibration. In the presented analysis the artificial standards are made from a lithium-boron-oxygen matrix while the whole coal samples are composed essentially of a carbon-hydrogen-oxygen matrix. The conclusion is that energy dispersive x-ray fluorescence is a viable technique for analyzing coal for elemental composition and ash content.

0108 Waste Management

REFER ALSO TO CITATION(S) 27725, 27789, 27790, 27806, 27821, 29205

27793 **(CES—474) Spray dryer/electron beam removal of SO_2 and NO/sub x/ from flue gas. Technical progress report, October 1, 1982-October 1, 1983.** Helfritch, D.J. (Cottrell Environmental Science, Somerville, NJ (USA)). Nov 1983. Contract FC22-81FE15079. 30p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE84011776.

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The objective of this project is the pilot scale evaluation of SO_2 and NO/sub x/ removal from flue gas by means of a lime slurry spray dryer followed by electron beam treatment. Capital and operating costs of this technique have been determined and been shown to be cost effective. The pilot scale work will serve to verify the cost study assumptions and to provide design guidelines for commercial applications. The pilot scale system, consisting of a spray dryer, electron beam and fabric filter, will treat a flue gas slipstream from a 150 MW coal fired boiler. Parameters such as lime reactant rate and electron beam dosage will be varied, and SO_2 and NO/sub x/ removal will be monitored. It is expected that better than 90% removal of SO_2 and NO/sub x/ will be achieved with reasonable operating costs. 2 references, 10 figures, 1 table.

27794 **(DOE/PC/60261—2) Research and development for advanced combined NO/sub x/SO_2 removal systems. Technical progress report No. 2, October 1-October 31, 1983.** Kanter, I.E. (Department of Energy, Pittsburgh, PA (USA). Pittsburgh Energy Technology Center). May 1984. Contract AC22-83PC60261. 12p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE84012121.

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This project will evaluate the feasibility of using a glow discharge chemical reactor to simultaneously remove at least 90% of the NO/sub x/ and SO_2 from coal-fired combustion flue gases from utility and industrial sources. The 24 month study proceeds in three phases starting with feasibility tests on a 75 CFM unit, through optimization and operation of a 600 CFM module. Characterization of the final product will be made. During this reporting period, the status of the 75 CFM unit is discussed. The results of preliminary electrode tests were not encouraging. Although the dicharge curtain was extremely stable and filled the complete flow area, the discharge thickness was much less than with other orthogonal configurations. Also, the use of an opposing screen did not fill-out the discharge cone. The chemical reaction which occurs in the discharge is a strong function of (among other variables) the residence time in the discharge and the power input to the discharge. Neither of these parameters were overly encouraging in the single pin tests on house air. Discharge physics and chemistry are also discussed as well as electron kinetics. Briefly described is the formulation we are using to model the behavior of our corona glow discharges and presents predicted electron impact excitation, ionization and attachment rate coefficients for moist air which contains 0.1% (1000 ppM) H_2O and 10 ppM NO. Similar calculations are planned for flue gas mixtures containing CO, CO_2, H_2 and SO/sub x/. 9 references, 1 table. (DMC)

27795 **(DOE/PC/60261—3) Research and development for advanced combined NO/sub x//SO_2 removal systems. Technical progress report No. 3, November 1-November 30, 1983.** Kanter, I.E. (Westinghouse Electric Corp., Pittsburgh, PA (USA)). Dec 1983. Contract AC22-83PC60261. 9p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE84012156.

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This project will evaluate the feasibility of using a glow discharge chemical reactor to simultaneously remove at least 90% of the NO/sub x/ and SO_2 from coal-fired combustion flue gases from utility and industrial sources. The 24 month study proceeds in three phases starting with feasibility tests on a 75 CFM unit, through optimization and operation of a 600 CFM module. Characterization of the final product will be made. During this reporting period, the coaxial design concept was built and tested on house air at flowrates to 15 SCFM and found to be unstable. Rate coefficients for the electron impact excitation processes, which are the first steps in the glow discharge chemical processing, were calculated. Also calculated are the rate coefficients for a large number of electron impact excitation, ionization and dissociation reactions in a flue gas mixture by performing an electron energy balance calculation. 1 reference, 2 figures, 1 table. (DMC)

27796 **(DOE/PC/60261—5) Research and development for advanced combined NO/sub x//SO_2 removal systems. Technical progress report, January 1-31, 1984.** Kanter, I.E. (Westinghouse Electric Corp., Pittsburgh, PA (USA)). Feb 1984. Contract AC22-83PC60261. 9p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE84012157.

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This project will evaluate the feasibility of using a glow discharge chemical reactor to simultaneously remove at least 90% of the NO/sub x/ and SO_2 from coal-fired combustion flue gases from utility and industrial sources. The 24 month study proceeds in three phases starting with feasibility tests on a 75 CFM unit, through optimization and operation of a 600 CFM module. Characterization of the final product will be made. During this reporting period, the design of the 75 CFM unit was completed. This design also represents a modular approach for construction of the 600 CFM unit. The modular 75 CFM unit is designed to stack on the periphery of an octagon to give rise to a discontinuous set of octogonal flow slits. This design concept will be considered as the back-up design if the coaxial cylindrical design is not used. The coaxial design is now operating at 30 CFM per sub-module and is very stable. An appraisal of available gas analyzers is being conducted. 3 figures. (DMC)

27797 **(EPRI-CS—3369-Vol.1) Utility FGD survey, July 1982-March 1983. Volume 1. Categorical summaries of FGD systems.** Melia, M.T.; McKibben, R.S.; Pelsor, B.W. (PEDCo-Environmental, Inc., Cincinnati, OH (USA)). Apr 1984. 364p. EPRI-RRC, Box 50490, Palo Alto, CA 94303. Order Number DE84920213.

This two-volume report, which is generated by a computerized data base system, represents a survey of operational and planned domestic utility flue gas desulfurization (FGD) systems. It summarizes information contributed by the utility industry, system and equipment suppliers, system designers, research organizations, and regulatory agencies. The data cover system design, fuel characteristics, operating history, and actual system performance. Also included is a unit-by-unit discussion of problems and solutions associated with the boilers, scrubbers, and FGD systems. Along with the design and performance data for operational FGD systems contained in Section 3, this report also presents tabulations of some of the key data. The Executive Summary contains the number and capacity of FGD systems as of the end of March 1983, future (December 1991) projections of controlled and uncontrolled generating capacity, and unit-by-unit summaries of status changes (e.g., contract awarded, under construction, or operational) and performance (problems/solutions/comments) during the period. Simplified process flow diagrams of FGD systems, definitions, and a glossary of terms are attached to the report. Current data for domestic FGD systems show 106 systems in operation, 35 systems under construction, and 70 systems planned. The current FGD-controlled capacity in the United States is 41,894 MW.

27798 **(EPRI-CS—3369-Vol.2) Utility FGD survey, July 1982-March 1983. Volume 2. Design and performance data for operational FGD systems.** Melia, M.T.; McKibben, R.S.; Pelsor, B.W. (PEDCo-Environmental, Inc., Cincinnati, OH (USA)). Apr 1984. 1077p. EPRI-RRC, Box 50490, Palo Alto, CA 94303. Order Number DE84920342.

This two-volume report, which is generated by a computerized data base system, represents a survey of operational and planned domestic utility flue gas desulfurization (FGD) systems. It summarizes information contributed by the utility industry, system and equipment suppliers, system designers, research organizations, and regulatory agencies. The data cover system design, fuel characteristics, operating history, and actual system performance. Also included is a unit-by-unit discussion of problems and solutions associated with the boilers, scrubbers, and FGD systems. This volume contains design and performance data for operational FGD systems. The development status (operational, under construction, or in the planning stages), system supplier, process, waste disposal practice, and regulatory class are tabulated alphabetically by utility company. Simplified process flow diagrams of FGD systems, definitions, and a glossary of terms are attached to the report. Current data for domestic FGD systems show 106 systems in operation, 35 systems under construction, and 70 systems planned. The current FGD-controlled capacity in the United States is 41,894 MW.

27799 **(EPRI-CS—3475) Stabilization of power plant by-product storage sites for building development. Final report.** Stewart, M.M.; Goldberg, G.D. (Baker (Michael), Jr., Inc., Beaver, PA (USA)). Apr 1984. 177p. Electric Power Research Inst., Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number DE84920324.

Many coal-fueled power plants are located in congested areas where the availability of land is limited and the price of land is high. As a result, utilities located in these areas are generally faced with significant land management problems. The stabilization of by-product storage areas could minimize these problems by increasing land use for additional storage or building development. The objective of this study was to assess current methods of lands stabilization with respect to the improved land use and reclamation of power plant by-product storage areas. This assessment was based primarily on an office study of available literature with field work limited to contractor/engineer/owner interviews and construction site visits. Several potentially feasible stabilization techniques were identified during the study. Field demonstrations were recommended for the three techniques considered most feasible for stabilizing power plant by-product storage areas: dynamic consolidation (with

and without wick drains), preloading/surcharging (with and without wick drains), and dewatering using wellpoints. Potential demonstration sites were identified by conducting a survey of over 200 power plants. 154 references, 18 figures, 15 tables.

27800 **(LBL—17740) Simultaneous stripping and solvent extraction for the recovery of ammonia and acid gases from wastewaters.** Mackenzie, P.D.; King, C.J. (Lawrence Berkeley Lab., CA (USA)). Apr 1984. Contract AC03-76SF00098. 395p. NTIS, PC A17/MF A01; 1; GPO Dep. Order Number DE84011816.

Portions are illegible in microfiche products; Thesis. Submitted by P.D. MacKenzie.

A processing approach is proposed which has the potential for reducing energy requirements for the recovery of ammonia and acid gases (e.g. CO_2 and H_2S) from wastewaters. Two separation processes, solvent extraction and steam stripping, are carried out simultaneously. One process preferentially removes the acid gases, the other the basic gas (NH_3). The key to the process is the identification of a suitable solvent for one of the components. No common solvents were found to be effective for extraction of either CO_2 or H_2S at the usual pH of such wastewaters. Only liquid cation exchangers were found to be suitable extractants for ammonia. Solvents containing an acid of intermediate strength, di-2-ethylhexyl phosphoric acid (D2EHPA) have more favorable properties. Diluent choice affected the properties of D2EHPA-containing solvents. Batch experiments comparing solvent extraction/stripping with stripping alone confirmed that the former resulted in increased CO_2 volatility and served to isolate NH_3 from CO_2. Analysis of the overall economics of the process indicates that costs for replenishment of D2EHPA due to aqueous solubility losses and for the energy to regenerate the solvent are dominant. An improved extractant is needed if this approach is to offer economical advantages over other established approaches for recovering and isolating ammonia from such water streams.

27801 **(TVA/PUB—84/34) TVA's SO_2 control options - today and tomorrow.** Hollinden, G.A.; Maxwell, J.D.; Massey, C.L. (Tennessee Valley Authority, Chattanooga (USA). Div. of Energy Demonstrations and Technology). 1984. 25p. (CONF-840612—11). NTIS, PC A02/MF A01. Order Number DE84901038.

From Air Pollution Control Association annual meeting; San Francisco, CA, USA (25 Jun 1984).

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In the past few years TVA has implemented various SO_2 emission control procedures on its coal-fired plants, such as coal cleaning, limestone-scrubbing FGD, and switching to low-sulfur coals. These emission reduction strategies, in combination with conservation and reduced power demand, improved heat rates, and additional nuclear generation, have greatly reduced the quantity of SO_2 emitted by TVA, with the 1983 SO_2 emissions being less than half the 1977 SO_2 emissions. Although great progress has been made, potential changes in SO_2 emission regulations to control acid rain could have profound effects on the use of FGD by TVA and other eastern utilities, e.g., increased use of FGD, upgrading of existing FGD systems, and the accelerated adoption of new technology. With a total FGD capacity of 2500 MW already installed and test facilities for advanced FGD and combustion technology (AFBC) planned, TVA is continuing to assess controlling SO_2 emissions in the future. Even though limestone scrubbing is expected to be the primary method, at least through the rest of the century, innovations, such as the use of additives (adipic and dibasic acid), and new processes, such as limestone double alkali and dry FGD (spray dryer), should increase in importance and move into commercial use in the near future, particularly if the need for wider use of FGD occurs. AFBC, in which SO_2 removal is an integral function, is reaching an advanced stage of development and could serve to reduce the use of FGD at new facilities by the latter half of the 1990s.

0109 Environmental Aspects

REFER ALSO TO CITATION(S) 27725, 27739, 27753, 27815, 27816, 29262, 29273, 29300

27802 **(DOE/EV/04960—T1) Formation and transformation of particulate polycyclic organic matter emitted from coal fired power plants and oil shale retorting. Final report.** Natusch, D.F.S. (Colorado State Univ., Fort Collins (USA)). Apr 1984. Contract AC02-78EV04960. 1044p. NTIS, PC A99; 3; GPO Dep. Order Number DE84012747.

Paper copy only, copy does not permit microfiche production.

This report is concerned with the nature, chemical behavior, and potential effects of fly ash derived from coal combustion, and of particulate matter which is likely to be produced from oil shale retorting. It represents the findings of an extended research programme directed by the author, and sponsored by the US Department of Energy. In its entirety it provides a coherent suggestion of the manner in which such fly ashes are formed; of their possible transformations both during and following emission to the atmosphere; and of the possible environmental effects which these particles might have. In essence, it provides a set of both data and ideas which may, hopefully, form the basis for more detailed and specific investigations. The report is sub-divided into several sections which address: (1) characterization of the inorganic constituents of fly ash and the formation thereof; (2) the ways in which potentially carcinogenic polycyclic organic matter may be associated with coal fly ash; (3) the analytical determination of polycyclic organic matter associated with particles emitted to the atmosphere, and investigation of the chemical transformations which may occur thereafter; and (4) the characteristics and chemical transformations of particles derived from oil shale retoring; primarily with respect to associated polycyclic organic matter.

27803 (ORNL—6009, pp 66-67) **Fossil Energy Program.** Apr 1984. NTIS, PC A09/MF A01. Order Number DE84010672. TI84010672

In Environmental Sciences Division annual progress report for period ending September 30, 1983.

Critical reviews of the literature on environmental transport, fate, and effects of direct coal liquefaction products, wastewaters, and atmospheric emissions, with emphasis on the SRC-I and SRC-II, H-Coal, and Exxon Donor Solvent processes, were done to assess the status of research that had been accomplished and to serve as a basis for planning future research programs. The reviews are organized around the following topics: (1) the initial issues that were believed to be important for the assessment of the transport, fate, and effects of direct coal liquefaction products, effluents, and emissions; (2) the research done to address these issues; (3) the initial issues that have been resolved by this research; and (4) additional research needs.

27804 **(PB—84-146448) Environmental assessment of surface mining methods: head-of-hollow fill and mountaintop removal. Volume 1. Final report, Nov 75-Apr 80.** (Skelly and Loy, Harrisburg, PA (USA)). Jan 1984. 224p. NTIS, PC A10/MF A01.

See also PB84-146455 and PB-300 540.

This study was undertaken to assess the environmental effects of coal mining and reclamation techniques employed in Kentucky and West Virginia mountaintop removal and head-of-hollow fill construction. Phase III results are reported in this document. Phase III work consisted of a detailed environmental assessment conducted at two surface coal mine sites in Kentucky and West Virginia, including study of rainfall/runoff relationships, water quality, stream benthic macroinvertebrate community, and terrestrial vegetation. Also included was an introductory investigation into head-of-hollow fill stability and a study of fugitive dust emissions generated by Appalachian coal mines.

27805 **(PB—84-146455) Environmental assessment of surface mining methods head-of-hollow fill and mountaintop removal. Volume 2. Final report, Nov 75-Oct 81.** (Skelly and Loy, Harrisburg, PA (USA)). Jan 1984. 122p. NTIS, PC A06/MF A01.

See also PB84-146448.

As a portion of the EPA study 'Environmental Assessment of Head-of-Hollow Fill and Mountaintop Removal Mining,' this volume documents the evaluation of the long-term stability of four head-of-hollow fills. Three phases of work included in the endeavor are: collection of samples of valley fill material at several locations; determination of sample moisture content, density and shear strength; and application of these parameters to stability analysis, analysis of water carrying capacity of rock chimney drains, and evaluation of the reliability and effectiveness of remote data collection techniques.

27806 **(PB—84-163708) Hydrogeologic investigation of the Ritchie Road site. Final report.** Bandoian, C.A.; Simek, E.M. (Environmental Resources Management, Inc., West Chester, PA (USA)). Dec 1983. 55p. NTIS, PC A04/MF A01.

The purpose of this report is to describe the results of a study of ground and surface water quality at coal ash site located near an aquifer recharge area. The Ritchie Road site was investigated to determine whether or not coal ash is affecting the environment under these specific set of site conditions. Between 1950 and 1980, ash from burning coal to produce electricity was placed at over 40 sites in the State of Maryland. One of these sites is the Ritchie Road site, a six-acre property located in Prince Georges County. Ash and other materials, such as construction debris and a few discarded automobile parts and appliances, were placed as fill on this low, marshy property in the 1960s to raise its elevation for commercial development.

27807 **(PB—84-165356) Atlas of wetlands in the principal coal surface mining region of western Kentucky. Reference report.** Mitsch, W.J.; Taylor, J.R.; Benson, K.B.; Hill, P.L. Jr. (Louisville Univ., KY (USA)). Jul 1983. 144p. NTIS, PC A07.

This reference document provides information on the location of wetlands in the Western Kentucky Region where coal surface mining is an important industry, principally Muhlenberg, Hopkins, and Ohio Counties. The wetlands and fish and wildlife data are presented on U. S. Geologic Survey 1:24,000 scale Quad maps and tables. The discussion focuses on historical information on the wetlands, occurrence of selected species in various kinds of wetlands, and environmentally important factors affecting the biota through surface mining activities.

0110 Reserves And Exploration

27808 **(DOE/ET/12507—T1) Reserve base of bituminous coal and lignite in Alabama. Final report.** Ward, W.E. II. (Alabama Geological Survey, University (USA)). Mar 1984. Contract FG01-77ET12507. 123p. NTIS, PC A06/MF A01; 1; GPO Dep. Order Number DE84009376.

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The following conclusions can be drawn: (1) as of January 1, 1978, Alabama's identified bituminous coal resources were 23.5 billion tons. The State's demonstrated reserve base bituminous coal was of 4.9 billion tons; (2) both the resource and reserve base figures are conservative because of the constraints imposed by the criteria adopted for this study and because of the uneven spatial distribution of the data; (3) attempts to identify historical production data for individual coal beds using incomplete records and direct physical measurement of mined areas gave figures that conflicted with total historical production; (4) the identified resource estimate prepared for this study provides a data base for future resource/reserve base studies; and (5) Alabama has a demonstrated reserve of lignite under less than 250 feet of overburden of 289.3 million tons (Self, 1978) with an inferred reserve of 2 billion tons (Daniel, 1973). Deep basin lignite resources under 250 to 6000 feet of overburden total 470 million tons of demonstrated resources and 3.7 billion tons of inferred resources (Self, 1978). 21 references, 6 figures, 4 tables.

27809 **(DOE/MC/10643—T1) Coal bed methane potential of the Raton Mesa coal region, Raton Basin, Colorado.** Tremain, C.M. (Colorado Geological Survey, Denver (USA)). 1980. Contract FG21-79MC10643. 108p. NTIS, PC A06/MF A01; 1; GPO Dep. Order Number DE84012843.

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The Raton Mesa coal region of Colorado is an 1100 sq mi area in the western portion of the Raton Basin. Coal rank data, desorption of coal samples, structure mapping on the Trinidad Sandstone, isopach mapping of Vermejo coal beds, coal mine methane emission data, and records of oil and gas tests in the region all define a 179 sq mi area containing 1.56 trillion cubic ft of gas in Vermejo coal beds. These Vermejo coals occur in beds up to 14 ft thick; total coal thicknesses in the Vermejo Formation reach a maximum of 30 ft in the 179 sq mi high potential area. These coals contain up to 514 ft^3 of gas per ton of coal and are less than 2000 feet below the surface in the high potential area. Currently, 3 wells are being drilled to test these Vermejo coals. 33 references, 26 figures, 3 tables.

27810 **(PB—84-156330) Geologic disturbances in Illinois coal seams.** Nelson, W.J. (Illinois Inst. of Natural Resources, Champaign (USA). State Geological Survey Div.). 1983. 53p. NTIS, PC A04/MF A01.

Mining problems result when coal seams are broken, distorted, or intruded upon by geologic features such as: channels, (Pleistocene or Pennsylvanian riverbeds) filled with rock or unconsolidated deposits that cut into coal seams, weaken roof strata, and store groundwater. Near some channels, coal may be thick, low in sulfur and high in ash content--and splits, (overbank or floodwater deposits in peat swamps) that are layers of noncoal materials divide coal seams horizontally; they either make it impossible to mine the seam as one unit, or increase the product's waste rock and ash content. rolls, (small, infilled channels) or lenses of roof rock that protrude into the top of coal seams, producing steep dips or abruptly thin seams as well as poor roof conditions. Clay dikes, (vertical, clayfilled cracks in peat) that intrude from overlying rock into coal seams, increase the product's waste rock and ash content, and cause unstable roof conditions. igneous dikes, (Magma-filled fractures in coal seams) intrude steep walls of rock into coal seams; they may be surrounded by coal coked from the heat of the magma. coal balls, (mineralized peat)--so hard and dense compared to the surrounding coal that massive deposits damage mining equipment and sometimes halt operations.

27811 **(PB—84-158021) Evaluation of geophysical surface methods for measuring hydrological variables in fractured rock units. Open file report, 9 Jul 81-23 Aug 83.** Taylor, R.W. (Wisconsin Univ., Milwaukee (USA)). Nov 1982. 147p. NTIS, PC A07/MF A01.

A simplified theoretical model for the use of electrical resistivity measurements to determine joint orientation and intensity was developed. A field procedure based on the theoretical model was applied to a physical model under laboratory conditions and at two field sites. The two field sites were identical geologically but differed in that one site was intensely mined while the other site was unmined. In all three cases, joint strike was determined within approximately 5 degrees and the relative indications of joint intensity were correct. In addition to the electrical measurements, the anisotrophy associated with seismic measurements, in comparison to the electrical measurements, were much less informative and more difficult to interpret. A computer-automated system for the continuous monitoring of resistivity depth soundings was deployed at one of the field sites.

0120 Mining

REFER ALSO TO CITATION(S) 27723, 27810, 27838

27812 **(DOE/FE/00016—T34) Longwall mining dust control. Technical progress report No. 26, September 1-30, 1983.** (Foster-Miller Associates, Inc., Waltham, MA (USA). Engineering Systems Group). 14 Oct 1983. Contract AI01-81FE00016. 7p. NTIS, PC A02/MF A01; GPO Dep. Order Number DE84012749.

Dust measurements in two underground longwall mines are reported and analyzed. Shearer generated dust was the major dust source affecting personnel, at least partly because the shearer cut some bottom and top rock as well as rock inclusion - also low air velocity limited its dilution by ventilating air. (LTN)

27813 **(DOE/MC/10513—T7) Task 6 - field monitoring and evaluation of MRCP resource application. Technical progress report No. 47.** (Harrison and Associates, Engineers, Inc., Denver, CO (USA)). 21 Sep 1983. Contract AM21-79MC10513. 9p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE84011380.

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Task 6 monitoring and evaluation activities were continued during this reporting period. Task 6 is part of the continuing effort by Harris and Associates, Engineers, Inc., to monitor and evaluate contract research for the DOE/METC Methane Recovery from Coalbeds Project. Harris and Associates responsibilities under this task include field site monitoring and reporting on Coalbed Methane Resource Applications projects supported by the DOE. Proposal effort by the Muckleshoot Tribe/CERT continues on the potential Muckleshoot Tribe RA project. The Muckleshoot Tribe/CERT is completing their revised proposal and has scheduled a meeting between DOE/Region VIII personnel and themselves to finalize the arrangement. The DOE/Region VIII office has determined a way to fund the project with de-committed RA project funds. The Ute Tribe RA project has been delayed and will probably start in mid-September 1983. Through phone conversations project personnel stated they expected to complete contractor qualifications requirements soon. During this period, Harris and Associates has monitored progress on the Ute and Muckleshoot projects through telephone contacts. Harris and Associates will participate in the Muckleshoot proposal meeting to assist DOE/Region VIII. Harris and Associates has also maintained contact with DOE/METC and DOE/Region VIII.

27814 **(DOE/METC/SP—202) Coalbed methane recovery and utilization in the United States.** (USDOE Morgantown Energy Technology Center, WV). Dec 1983. 47p. NTIS, PC A03/MF A01; GPO Dep. Order Number DE84000221.

The United States Department of Energy (DOE) has a commitment to assist the private sector in the development of the commercial use of coalbed methane through the Coalbed Methane Project. This project is an intergral part of the Unconventional Gas Recovery (UGR) Program with lead responsibility assigned by the DOE Assistant Secretary of Fossil Energy to the Morgantown Energy Technology Center (METC). The DOE effort has been implemented as an integrated project, combining the research and development efforts of private industry, universities, and federal and state agencies to enhance the coalbed methane data base. The project goals are to estimate the extent of the resource with increased accuracy and reliability and to provide technically and economically viable means for methane recovery and utilization. The ultimate purpose of the project is to promote extensive private use of the resource as a source of national energy. To date, the major emphasis has been directed toward locating and estimating the magnitude of the resource, estimating the recoverable reserves, developing economical recovery systems and techniques, and demonstrating utilization in an appropriate manner. To ensure proper integration of ongoing activities, heavy emphasis is placed on project planning and review, tailored within the frameworks of the DOE Gas Resources Research, Development, and Demonstration Plan and the UGR Program Charter. DOE has made significant progress in the development of the technology data base. Major achievements produced by the project to date are discussed briefly in this report. Contents of this report include the following: introduction; resource research; recovery and utilization technology development; production constraints; technology assessment; appendices; and glossary of acronyms and abbreviations. 8 references, 20 figures, 9 tables.

27815 **(NP—4901102) Earth resistivity investigations in reclaimed surface lignite mine spoils.** Kehew, A.E.; Groenewold, G.H. (North Dakota Geological Survey, Grand Forks (USA)). 1983. 97p. NTIS, PC A05/MF A01. Order Number DE84901102.

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Earth resistivity surveys using the Wenner electrode configuration were made in unmined areas and reclaimed spoils at three surface lignite mines in western North Dakota. The study sites were the Center, Indian Head, and Falkirk Mines. Automatic interpretation of the curves was accomplished with the method of Zohdy and Bisdorf (1975). Overburden materials become more homogeneous with respect to resistivity during the mining and reclamation process. The spoils curves show localized heterogeneities probably related to discontinuous moisture content variations in the spoils. Consistent resistivity differences in spoils occur between mines with overburdens of different mineralogic compositions. Groundwater chemical composition in terms of total-dissolved-solids (TDS) is inversely correlated ($r = -0.61$) with apparent resistivity at the 80-foot spacing from a survey centered at a piezometer screened near the base of the spoils. Better inverse correlation is probably prevented by high variability in TDS within the spoils groundwater. A useful predictive relationship may be the plot of mean apparent resistivity at the 80-foot spacing for an entire mine against mean TDS for all wells in spoils at that mine.

27816 **(PB—84-148535) Evaluation of a surface application of limestone for controlling acid mine discharges from abandoned strip mines, Sewellsville, Ohio. Final report.** Geidel, G.; Caruccio, F.T. (South Carolina Univ., Columbia (USA)). Jan 1984. 185p. NTIS, PC A09/MF A01.

A 150-acre drainage basin in an unreclaimed coal strip mine in east-central Ohio was studied and extensively monitored to determine the effect of a surface application of limestone on the ground water quality. Prior to the limestone treatment the ground and surface water of the basin was acidic due to pyrite oxidation in the spoil. The results of this field study and simultaneous laboratory experiments showed that the maximum amount of alkalinity that can be generated by a surface application of limestone is not sufficient to reduce the ground water acidity generated by pyrite oxidation. Additionally, the amount of limestone applied was not sufficient to significantly decrease the rate of pyrite oxidation nor provide neutralization and thereby produce neutral or alkaline discharges from the abandoned coal strip mine sites.

27817 **(PB—84-152123) Vertical magnetic noise in the voice frequency band within and above coal mines. Report of investigations/1983.** Durkin, J. (Bureau of Mines, Pittsburgh, PA (USA). Pittsburgh Research Center). Dec 1983. 34p. NTIS, PC A03/MF A01.

Library of Congress catalog card No. 83-600164.

Information on vertical magnetic noise in the voice frequency band, both within and above coal mines, is needed for the evaluation of through-the-earth baseband electromagnetic communications at mines where horizontal loop antennas are used. This report discusses the theory of the source of electromagnetic noise, the propagation of this noise to an observation point above a mine, and its interaction with the local earth conductivity structure, which gives rise to vertical magnetic noise. The relationship of surface noise to underground noise is also discussed. Bureau of Mines investigators made surface and underground vertical magnetic noise measurements at a number of coal mines located throughout the United States. These data were modeled through regression analysis to characterize expected noise levels. The results are presented, including results in one-third octaves for use in evaluating the expected performance of through-the-earth communication systems by articulation-index studies.

27818 **(PB—84-152164) Economic evaluation of directional drilling for methane drainage from coalbeds. Report of investigations/1984.** Baker, E.C.; Oyler, D.C.; Perry, J.H.; Finfinger, G.L. (Bureau of Mines, Pittsburgh, PA (USA). Pittsburgh Research Center). Dec 1983. 18p. NTIS, PC A02/MF A01.

Library of Congress catalog card No. 83-600295.

The Bureau of Mines estimated the economic feasibility of investing in a directional hole methane drainage project in the Pittsburgh coalbed for 5 yr in advance of mining. This report estimates the capital investment and operating cost of recovering 325 million cubic feet of methane gas per year and the selling price of approximately 317 million cubic feet of gas per year. The labor, equipment, and supply requirements were determined from those of a previous directional hole drilled at the Emerald Mine, near Waynesburg, PA. The cost of equipment, materials, services, and labor are in third quarter 1982 dollars. They were obtained from vendors, contractors, and the U.S. Department of Labor.

27819 **(PB—84-152958) Mining machinery noise control guidelines, 1983: bureau of mines handbook.** Bartholomae, R.C.; Parker, R.P. (Bureau of Mines, Pittsburgh, PA (USA). Pittsburgh Research Center). Dec 1983. 90p. NTIS, PC A05/MF A01.

Library of Congress catalog card No. 83-600114.

The Mine Health and Safety Act of 1977 seeks to protect miners by regulating their exposure to excessive noise in the mining environment. When a worker's exposure is found to be excessive, the utilization of existing engineering noise control measures are required to abate the noise. Over the past decade, the Bureau of Mines has undertaken a number of noise control programs aimed at establishing a technology base that can be used by industry to effect solutions to noise problems. Many of these hardware-oriented programs have provided the development and demonstration of retrofit noise control treatments for mining machinery. The purpose of this Handbook is to synthesize evolving and available noise control information and disseminate it within the mining industry.

0130 Transport And Handling

REFER ALSO TO CITATION(S) 27718, 27773, 27801, 28540

27820 **(AD-P—002636/9) Coal port analysis.** Wootton, F.T. Jr. (Army Engineer District, Norfolk, VA (USA)). Oct 1983. 11p. NTIS, PC A02/MF A01.

The authorized project currently serving Hampton Roads provides for a channel 45 feet deep and 1,000 feet wide in the lower Chesapeake Bay (Thimble Shoal) to Hampton Roads. In Hampton Roads, channels 45 feet deep with widths of from 800 to 1,500 feet provide access to the Norfolk and Western coal-loading facility in Norfolk and the CSX coal-loading facility in Newport News. Channels of lesser depths are also maintained up the Elizabeth River. Maintenance of the existing channels and anchorages inside Hampton Roads Harbor, including permit dredging, requires the removal of approximately 4 to 5 million cubic yards of dredged material annually.

27821 **(DOE/ET/10502—T1) Preparation, characterization and flotation of colloidal coal.** Rubin, A.J.; Kramer, R.J. III. (Ohio State Univ., Columbus (USA). Dept. of Civil Engineering). Oct 1979. Contract FG01-77ET10502. 66p. NTIS, PC A04/MF A01; 1; GPO Dep. Order Number DE84011261.

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This project was undertaken as a preliminary study of the recovery of colloidal coal from blackwash waters using some novel flotation techniques. The specific objectives of this phase of the research were: (1) to develop a procedure for the preparation of colloidally stable and reproducible suspensions of ultrafine coal particles; (2) to characterize the colloid-chemical properties of these coal suspensions; (3) to investigate the feasibility of dispersed-air colloid flotation as an effective recovery method under laboratory conditions; and (4) to survey the major parameters that might control the flotation process. These objectives have been met by the research program. Based on the results of the study the following findings and conclusions are indicated: (1) Stable and reproducible suspensions of colloidal coal can be produced through a process in which the coal is ground, ball milled, sieved to -400 mesh, oxidized with hydrogen peroxide at elevated temperatures, washed and filtered, and finally resuspended in distilled water. The specific surface area of the oxidized coal particles is about 8 m^2/g. (2) The colloidal coal so produced has properties similar to other negatively charged sols. Coagulation of the coal with electrolytes follows the Schulze-Hardy rule in that the plot of the logarithm of the critical coagulation concentration against counterion change is linear. (3) The colloid flotation of the oxidized coal can be successfully achieved using CTAB, a cationic collector, in the presence of ethanol frother. 40 references, 17 figures, 3 tables.

27822 **(DOE/PC/40807—T10) Flow and design characteristics of the hydrocyclone for the recovery of coal fines. Final report.** Davis, P.K. (Southern Illinois Univ., Carbondale (USA). Dept. of Engineering Mechanics and Materials). Mar 1984. Contract FG22-81PC40807. 327p. NTIS, PC A15/MF A01; GPO Dep. Order Number DE84009968.

The objective of this project was to do a basic study to identify the flow and design variables of the conventional hydrocyclone and experimentally determine how each one individually affects its operation while all the others are held constant. Spheres were initially used to model solid particles. It was then to be seen if the data using spheres could be used to determine optimum configurations for given applications. The specific application of interest in this project is the separation of coal fines from waste materials such as gob or settling pond settlings. The relevant variables of the standard hydrocyclone have been identified. Two experimental hydrocyclone systems have been designed and constructed so that the flow rate, inlet area, vortex finder length and diameter, underflow diameter, length of hydrocyclone chamber and cone angle can all be varied, one at a time, while all other variables are held constant. It was first shown that the sphere data compares well with data using random shaped coal particles with approximately the same mean diameters as the spheres. Then a hydrocyclone configuration was selected, by use of the sphere data, to separate coal fines from gob material. Good coal fines recovery from the gob (mineral waste) samples has been achieved on a batch basis. Recovery of 99% to 100% of the coal fines in a sample of gob has been achieved in the size range of from 0.187 inch (0.0047 m) to 0.500 inch (0.0127 m). Recovery of approximately 91% was achieved in the size range of from 0.0937 inch (0.0024 m) to 0.187 inch (0.0047 m). It should be emphasized that these results were obtained on a batch basis. 97 references, 5 figures, 3 tables.

27823 **(DOE/RA/50665—T1) Western US steam coal exports to the Pacific Basin: port and marine task group.** (Western Governors Regional Energy Policy Office, Denver, CO (USA)). Nov 1981. Contract FG01-81RA50665. 263p. Western Governors' Policy Office, 3333 Quebec St., Suite 2000, Denver, CO 80207. Order Number DE84011395.

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Volume 5 sets forth considerations and options in developing coal ports on the West Coast of the US. It includes information on the size, configuration, and ownership of the present and planned world bulk vessel fleet, as well as factors affecting the cost and efficiency of sealift transportation alternatives - including Panamax and VLCCs. The report also covers capacity and timing of development for receiving ports, synthesized from research and discussions with industry and government officials in Japan, South Korea, and the Republic of China. The physical and environmental aspects of announced plans to expand West Coast port capacity, capital and operating costs, and lead times for port expansion are also covered. The report includes marine charts and serial photographs of the 26 planned West Coast port sites.

27824 **(NP—4770273) Technical and economical investigation of a distribution system for coal dust by means of computer-aided decision making.** Opalla, F. (Technische Univ. Berlin (Germany, F.R.). Fachbereich Bergbau und Geowissenschaften). 1 Jul 1982. 209p. (In German). NTIS (US Sales Only), PC A10/MF A01. Order Number DE84770273.

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The aim of this study was to accomplish a decision model, which can give assertions about the structure of an economical coal dust distribution system and about the expected costs, if up to date data is fed. Special considerations are taken for the safety problems by the transport and storage and for the difficulty of storage of coal dust in a large silo. The model enables the determination of the number and locations of storage, and to keep the overall costs of distribution in a minimum. The calculations using this model have shown that for anthracite distribution in West Germany a high distribution grade can be obtained with a relative small number of storage facilities.

27825 **(PB—84-151166) Slurry transport properties of graded coal waste. Rept of investigations/1983.** McKibbin, R.W.; Backer, R.R.; Busch, R.A. (Bureau of Mines, Spokane, WA (USA). Spokane Research Center). Dec 1983. 32p. NTIS, PC A03/MF A01.

Library of Congress catalog card No. 83-14484.

The Bureau of Mines conducted laboratory tests to determine the slurry transport and deposition properties of coal waste. A 188.5-ft pipe test loop was constructed with instruments to measure density, flow, and power and discharge, suction, and differential pressures. A 20-ton sample of Western coal waste was crushed and screened to 100 pct minus 1/2 in. Eight loop tests using this graded waste were run at slurry densities ranging from 1.15 (25 wt-pct solids) to 1.46 (60 wt-pct solids). The resultant friction-pressure gradients ranged from 0.06 to 0.24 ft of water per foot of 4-in standard steel pipe. Particle-size degradation was significant. In a typical loop test lasting 25 min, the minus 200-mesh fraction increased from 19 pct to 34 pct. Deposition tests showed that without the use of a flocculant, the slurries would not dewater when left to stand for 1 week. With flocculant, additional water was released; however, the settled slurries remained thixotropic. Further testing is necessary to determine their suitability for use as backfill material in active mines.

0140 Combustion

REFER ALSO TO CITATION(S) 28255

27826 **(DOE/PC/50266—6) Vaporization and devolatilization of coal water sprays. Sixth quarterly report for the period ending February 11, 1984.** Chigier, N.; Meyer, P.L. (Carnegie-Mellon Univ., Pittsburgh, PA (USA). Dept. of Mechanical Engineering). May 1984. Contract FG22-82PC50266. 23p. NTIS, PC A02/MF A01; GPO Dep. Order Number DE84011263.

Investigations of the vaporization and devolatilization of coal-water slurry sprays are underway in order to learn about the fundamental processes leading to combustion of coal-water slurries. In this past quarter studies of both coal-water slurry and water sprays produced by a Parker-Hannifin atomizer were made by high magnification stills and high-speed motion pictures. These two photographic methods have allowed a detailed examination of spray structure and dynamic spray behavior. The water and slurry sprays exhibit similar pulsations but the actual atomization of these two materials is quite different. Our early studies indicated that the water spray forms a much finer mist then the slurry under similar mass flow rates and atomizing air pressures. Therefore, in order to photograph the water spray more light is required since the total light obscuration of the water spray is higher. 5 figures, 2 tables.

27827 **(MTR—83W87-01) Assessment of coal-liquid mixtures in cooperating IEA countries. Volume I. Summary.** Foo, O.K.; Jamgochian, E.M. (Mitre Corp., McLean, VA (USA). METREK Div.). Jun 1983. Contract AC01-82FE60036. 62p. NTIS, PC A04/MF A01; 1; GPO Dep. Order Number DE84011223.

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This study was performed under the auspices of the International Energy Agency (IEA) in accordance with the Implementing Agreement for a Program of Research, Development and Demonstration on Coal-Liquid Mixtures (CLM). The study consists of two subtasks: Subtask A - Assessment of Potential CLM Utilization; and Subtask B - Development of a CLM Cooperative Plan. The results of the work under Subtask A and Subtask B are reported in Volumes II and III. Volume I is the summary of findings in Volumes II and III. The assessment of potential CLM utilization is based on oil-fired utility and industrial boiler populations in each participating country. The fuel oil consumption and the quantity of oil which could be backed out by switching to CLM's are estimated. Economic, institutional and environmental factors which influence CLM commercialization are discussed. The current status of COM and CWM technologies in the participating countries are reviewed. Three major areas are covered: CLM preparation, combustion and major equipment. The COM and CWM projects in each participating country are summarized in individual data reports and are analyzed to determine future cooperative CLM research and development corroborate the findings from the technology assessment to determine RD and D needs. 16 tables.

27828 **(MTR—83W87-02) Assessment of coal-liquid mixtures in cooperating IEA countries. Volume II. Potential utilization.** Foo, O.K.; Jamgochian, E.M. (Mitre Corp., McLean, VA (USA). METREK Div.). Jun 1983. Contract AC01-82FE60036. 172p. NTIS, PC A08/MF A01; 1; GPO Dep. Order Number DE84011224.

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This study was performed under the auspices of the International Energy Agency (IEA) in accordance with the Implementing Agreement for a Program of Research, Development and Demonstration on Coal-Liquid Mixtures (CLM). The study consists of two subtasks: Subtask A - Assessment of Potential CLM Utilization; and Subtask B - Development of a CLM Cooperative Plan. The results of the work under Subtask A and Subtask B are reported in Volumes II and III. Volume I is the summary of findings in Volumes II and III. The assessment of potential CLM utilization is based on oil-fired utility and industrial boiler populations in each participating country. The fuel oil consumption and the quantity of oil which could be backed out by switching to CLM's are estimated. Economic, institutional and environmental factors which influence CLM commercialization are discussed. 16 figures, 59 tables.

27829 **(MTR—83W87-03) Assessment of coal-liquid mixtures in cooperating IEA countries. Volume III. Technology assessment and RD and D needs.** Foo, O.K.; Jamgochian, E.M. (Mitre Corp., McLean, VA (USA). METREK Div.). Jun 1983. Contract AC01-82FE60036. 225p. NTIS, PC A10/MF A01; 1; GPO Dep. Order Number DE84011225.

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This study was performed under the auspices of the International Energy Agency (IEA) in accordance with the Implementing Agreement for a Programme of Research, Development and Demonstration on Coal-Liquid Mixtures (CLM). The study consists of two subtasks: Subtask A - Assessment of Potential CLM Utilization and Subtask B - Development of a CLM Cooperative Plan. The results of the work under Subtask A and Subtask B are reported in Volumes II and III. Volume I is the summary of findings in Volumes II and III. The current status of COM and CWM Technologies in the participating countries are reviewed. Three major areas are covered: CLM preparation, combustion and major equipment. The COM and CWM projects in each participating country are summarized in individual data reports and are analyzed to determine if any program overlaps or program gaps exist. The views on future cooperative CLM research and development corroborate the findings from the technology assessment to determine RD and D needs. 14 figures, 28 tables.

27830 **(MTR—83W87-04) Assessment of coal-liquid mixtures in cooperating IEA countries. Executive summary.** Foo, O.K.; Jamgochian, E.M. (Mitre Corp., McLean, VA (USA). METREK Div.). Jun 1983. Contract AC01-82FE60036. 40p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE84011222.

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This study was performed under the auspices of the International Energy Agency (IEA) in accordance with the Implementing Agreement for a Program of Research, Dvelopment and Demon-

stration on Coal-Liquid Mixtures (CLM). The study consists of two subtasks: Subtask A - Assessment of Potential CLM Utilization; and Subtask B - Development of a CLM Cooperative Plan. The results of the work under Subtask A and Subtask B are reported in Volumes II and III. Volume I is the summary of findings in Volumes II and III. The assessment of potential CLM utilization is based on oil-fired utility and industrial boiler populations in each participating country. The fuel oil consumption and the quantity of oil which could be backed out by switching to CLM's are estimated. Economic, institutional and environmental factors which influence CLM commercialization are discussed. The current status of COM and CWM technologies in the participating countries are reviewed. Three major areas are covered: CLM preparation, combustion and major equipment. The COM and CWM projects in each participating country are summarized in individual data reports and are analyzed to determine if any program overlaps or program gaps exist. The views on future cooperative CLM research and development corroborate the findings from the technology assessment to determine RD and D needs. 3 tables.

27831 **(PB—84-160951) Mechanistic and kinetic studies of the elementary processes in catalytic combustion of methane. Annual report, 1 Sep 82-31 Aug 83.** Kung, H.H.; Butt, J.B. (Northwestern Univ., Chicago, IL (USA)). Oct 1983. 28p. NTIS, PC A03/MF A01.

See also PB83-188615.

The reactions of ethylene and acetylene on a Pt(111) surface were studied with temperature programmed desorption/reaction spectroscopy. On a clean or an H-covered surface, successive dehydrogenation of ethylene and acetylene occurred. Hydrogen was desorbed in each dehydrogenation step, leaving the hydrocarbon fragment on the surface which eventually became a carbonaceous layer. By quantitatively measuring the flux of the desorbing species, the stoichiometry of the hydrocarbon fragments were determined. For ethylene, the first step in the dehydrogenation is the formation of adsorbed C2H3 which can be assigned to ethylidyne. On a surface with preadsorbed atomic oxygen, combustion of the hydrocarbon to CO2 and H20 dominated. However, on a surface only partially covered with oxygen, both the combustion reaction and the dehydrogenation reaction occurred simultaneously, indicating that the reactions of hydrocarbons are sensitive to the immediate environment of the surface atoms.

27832 **(PNL—4983) Chemical and toxicological characterization of organic constituents in fluidized-bed and pulverized coal combustion: a topical report.** Chess, E.K.; Later, D.W.; Wilson, B.W.; Harris, W.R.; Remsen, J.F. (Pacific Northwest Lab., Richland, WA (USA)). Apr 1984. Contract AC06-76RL01830. 123p. NTIS, PC A06/MF A01; GPO Dep. Order Number DE84012841.

Coal combustion fly ash from both conventional pulverized coal combustion (PCC) and fluidized-bed combustion (FBC) have been characterized as to their organic constituents and microbial mutagenic activity. The PCC fly ash was collected from a commercial utility generating plant using a low sulfur coal. The FBC fly ash was from a bench-scale developmental unit at the Grand Forks Energy Technology Center. Bulk samples of each fly ash were extracted using benzene/methanol and further separated using high performance liquid chromatography (HPLC). Subfractions from the HPLC separation were analyzed by gas chromatography using both element-specific nitrogen-phosphorus detectors and flame ionization detectors. Microbial mutagenicity assay results indicated that the crude organic extracts were mutagenic, and that both the specific activity and the overall activity of the PCC material was greater than that of the FBC material. Comparison of results from assays using S. typhimurium, TA1538NR indicated that nitrated polycyclic aromatic compounds (PAC) were responsible for much of the mutagenic activity of the PCC material. Similar results were obtained for assays of the FBC organic extract with standard and nitroreductase-deficient strains of S. typhimurium, TA100 and TA1538. Mutagenically active HPLC fractions were analyzed using high resolution gas chromatography (HRGC) and GC mass spectrometry (GC/MS), as well as probe inlet low and high resolutions MS. The discovery and identification of nitrated, oxygenated PAC are important because the presence of both nitro and/or keto functionalities on certain PAC has been shown to confer or enhance mutagenic activity.

27833 **(SAND—84-8008) Analysis of vapor formation from silica under coal combustion conditions.** Mar, R.W.; Nagelberg, A.S.; Carling, R.W. (Sandia National Labs., Livermore, CA (USA)). May 1984. Contract AC04-76DR00789. 31p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE84012229.

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A free energy minimization code for the calculation of complex chemical equilibrium has been used to study the behavior of vapor species resulting from the decomposition of silica. The partial pressures of gases formed from silica and silica-carbon mixtures under a variety of conditions that are believed to be relevant to coal combustion have been calculated.

27834 **Tube bank metal wastage in the Grimethorpe PFBC.** *Materials and Components in Fossil Energy Applications;* No. 48, 1-4(1 Feb 1984).

The 2 m x 2 m PFBC facility at Grimethorpe, England is designed to explore the pressurized fluidized-bed combustion of coal over a wide range of conditions. A significant degree of metal wastage was observed on the fireside surfaces of the tube bank which occurred during 468 coal-burning hours of hot shakedown and hot commissioning testing. This paper described the operating conditions during testing, the erosion of the metal surfaces, and the repair and modifications undertaken. 1 reference, 4 figures, 2 tables.

27835 **Performance of pressure control butterfly valves in the Grimethorpe PFBC.** *Materials and Components in Fossil Energy Applications;* No. 48, 5-6(1 Feb 1984).

The freeboard pressure in the Grimethorpe, PFBC is controlled by a pressure control valve on the exhaust gas after it has passed through the main heat exchanger. The system design specifies two 100% flow control valves and one 50% control valve for pressure control and relief duties. After several hundred hours of cold operation during commissioning plus 50 hr on coal, leakage past the gaskets on the upstream side of the 40.6 cm diameter valves was experienced, which caused erosion of the metal surfaces of the flanges. This paper describes the performance of these valves, the remedial measures taken to replace or repair the valves, and recommendations for more permanent solutions to valve erosion. 1 figure.

0150 Marketing And Economics

REFER ALSO TO CITATION(S) 28519, 28542

27836 **(EPRI-EA—3456-Vol.2) Nonutility demand for coal. Volume 2. Metallurgical and export coal demand.** Klein, D.E.; Schweers, K.A. (ICF, Inc., Washington, DC (USA)). Mar 1984. 171p. Electric Power Research Inst., Box 50490, Palo Alto, CA 94303. Order Number DE84920321.

Analyses are developed for five non-utility coal demand sectors: industrial boilers, industrial process heat applications, coke ovens, steam coal exports, and metallurgical coal exports. This volume examines the potential for coal consumption for domestic metallurgical use and for exports. Each analysis focuses on the development of an approach to evaluate competing coal demands in response to changing conditions. The methodologies presented are structural in nature and hence consider the underlying technological, economic, and political factors that determine non-utility coal demands. The forecasts of non-utility coal demand illustrate the application of these methodologies. 71 tables.

27837 **(GAO/RCED—84-113) Status of the Great Plains coal gasification project.** (General Accounting Office, Washington, DC (USA). Office of the Comptroller General). 22 Mar 1984. 29p. General Accounting Office, P.O. Box 6015, Gaithersburg, MD 20760. Order Number DE84901110.

Report to The Congress.

Construction of the Great Plains coal gasification plant in North Dakota was 95 percent complete and only about 2 weeks behind schedule as of November 30, 1983. Cumulative project costs were less than originally estimated for this date. Due to a drop in

forecasted energy prices, Great Plains, in September 1983, projected that plant operations could result in large after-tax losses and negative cash flows for the sponsors. Great Plains notified the Department of Energy that it was considering terminating its participation in the project in the absence of additional federal assistance. In this regard, additional assistance in the form of price guarantees for the project's synthetic natural gas are being considered by the US Synthetic Fuels Corporation.

0160 Health And Safety

REFER ALSO TO CITATION(S) 27778, 27819, 27832, 29216, 29217, 29501

27838 **(KFK—3525) Consequences of an expanded use of coal in the Federal Republic of Germany. Materials Vol. 3.** Schufmann, G.; Wiendieck, M. (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.)). Jan 1984. 71p. (In German). NTIS (US Sales Only), PC A04/MF A01. Order Number DE84751594.

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In this report, statistical data on accidents and occupational diseases in coal mining in the Federal Republic of Germany are analysed. Estimation of the relative frequency of accidents up to the year 2001 was derived from time-related data on the development of injured or workers killed per million tons produced hard coal. Quantitative and qualitative investigation of causes for mining accidents and the effectiveness of measures for accident prevention were also considered to support the assumptions on which the estimate is based. Analyses of occupational diseases can be limited to pneumoconiosis. This occupational disease will continue to decrease. A quantitative estimate of occupational diseases to be expected in the future was not performed due to reasons put forward in this report.

27839 **(PB—84-156009) Coal mine dust respiratory protective devices.** Harris, H.E. (Eastern Associated Coal Corp., Pittsburgh, PA (USA)). Oct 1974. 223p. NTIS, PC A10/MF A01.

See also PB82-151705.

Report on the current status of respirator usage and effectiveness in coal mining operations. Topics include field survey of possession and use of respirators, duration of use, job classification, training and maintenance, training programs, respirator maintenance, acceptability of respirators, models used, problems associated with respirator use, breathing difficulties, physical discomforts, suggestions for improvements; determination of respirator effectiveness under field conditions for coal and silica dust; field evaluation of single use respirators; and recommendations. Of three models evaluated, the Welsh model 7165 is considered acceptable by the miners wearing test units. Wearing discomfort and breathing resistance are cited by miners as the major disadvantages of half-mask respirators in general use in bituminous underground coal mining.

27840 **Teratogenicity following inhalation exposure of rats to a high-boiling coal liquid.** Springer, D.L.; Poston, K.A.; Mahlum, D.D.; Sikov, M.R. (Pacific Northwest Lab., Richland, WA). *JAT, Journal of Applied Toxicology;* 2: No. 5, 260-264(1982). Contract AC06-76RL01830.

On days 12-16 of gestation pregnant rats were exposed to heavy distillate (HD), the highest-boiling material derived from the solvent refined coal-II (SRC-II) process, and the litters were examined at day 21. Adverse biological effects were observed in the group of animals exposed to an aerosol concentration of 0.66 mg l^{-1} [1.8 μm, mass medium aerodynamic diameter (MMAD)]; groups of animals exposed to lower aerosol concentrations (0.084 and 0.017 mg l^{-1}) were largely unaffected. Embryolethality during mid- and late gestation appeared attributable to the coal liquid exposure. Fetuses from pregnant rats in the high exposure group were smaller in weight and length than fetuses from control animals, and skeletal ossification was reduced. Increased incidences of small lungs and cleft palate were observed in fetuses from the high exposure group. Pregnant rats in the high-exposure group gained less weight than controls during gestation; the reduced weight gain was accounted for by the reduced size of the fetuses and placentas. Even though maternal body weight (exclusive of the products of conception) was unaffected by the exposure, the weights of the maternal thymus, lung and spleen were altered in the high exposure group.

0170 Legislation And Regulations

27841 **(DOE/EIA—0444(EX)) International coal trade model: executive summary.** (USDOE Energy Information Administration, Washington, DC. Office of Coal, Nuclear, Electric and Alternate Fuels). May 1984. 29p. NTIS, PC A03/MF A01; 1 - GPO; GPO Dep. Order Number DE84012065.

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The International Coal Trade Model (ICTM), a static equilibrium model was used to analyze the international coal market and to assess the consequences of events and issues regarding world coal trade and US coal exports. The model forecasts world coal trade based on various assumptions concerning coal supply and demand. 13 figures.

02 PETROLEUM

27842 **(DOE/FE/30005—T1) II international conference on heavy crude and tar sands. Summary report.** (United Nations, New York (USA). Inst. for Training and Research). 1982. Contract FG01-81FE30005. 39p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE84008895.

Portions are illegible in microfiche products; Important for the Future, Vol. VII, Nos. 1 and 2.

The Second International Conference on Heavy Crude and Tar Sands clearly demonstrated that the world has abundant heavy and extra heavy crudes that will sustain the petroleum age for decades. Perhaps even more important for many developed and developing countries is that these resources are widely distributed throughout the world, for deposits are known to exist in at least forty-nine countries. Moreover, the rapid expansion over the last two and a half years of knowledge of the magnitude of these resources suggests there is much more to be added to the world's list of useful energy assets. The current ample supply of crude oil does not appear to have lessened the resolve to develop heavy crude and tar sands. Major industrial countries are eager to develop their heavy oil resources to free themselves from dependence on OPEC and the developing nations hope to reduce their cash outflows for imported oil which they can ill afford. Venezuela and Canada, which both have massive heavy crude reserves, are intent on developing their resources to supplement declining supplies of light oil. Despite the weakening international price of oil, the economics for many heavy crude ventures seem favorable. Statistics quoted at the conference suggest considerable heavy crude production can be brought on stream at costs approaching the finding costs of light conventional crude. At the same time, it has to be acknowledged that those large tar sands projects, like Alberta's multi-billion dollar ventures, are sufficiently marginal that they may be held back by current soft oil demand. This summary report covers the following areas: resources; international cooperation; production; environment; technological developments; upgrading and refining; marketing; and future of heavy crude oil and tar sands.

0201 Reserves

REFER ALSO TO CITATION(S) 27844

27843 **(USGS-OFR—83-598) Assessment of undiscovered conventionally recoverable petroleum resources of Northwestern, Central, and Northeastern Africa (including Morocco, northern and western Algeria, northwestern Tunisia, Mauritania, Mali, Niger, eastern Nigeria, Chad, Central African Republic, Sudan, Ethiopia, Somalia, and southeastern Egypt).** Peterson, J.A. (Geological Survey, Missoula, MT (USA)). 1983. 28p. USGS-OFS, Box 25425-Denver Federal Center, Denver, CO 80225. Order Number DE84900972.

This report was prepared as part of the World Energy Resources Program of the US Geological Survey (USGS). The objective of the study is to assess the undiscovered conventionally recov-

erable resources within the petroleum producing provinces. The study utilizes geological and petroleum engineering data, in conjunction with statistical techniques, to estimate undiscovered resources by a process involving a team of geologists and statisticians. The estimates represent the views of the US Geological Survey estimating team and should not be regarded as an official Department of the Interior position. 21 figures, 2 tables.

0202 Geology And Exploration

27844 (ANL/EES-TM—247) Geology and petroleum resources of basins in the Asian Arctic and offshore East Greenland. Ulmishek, G. (Argonne National Lab., IL (USA)). Jan 1984. Contract W-31-109-ENG-38. 109p. NTIS, PC A06/MF A01; 1; GPO Dep. Order Number DE84012114.

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The region discussed contains 15 or 16 almost unexplored sedimentary basins. This report considers the tectonic framework and history of development of the basins, the stratigraphy and facies of their sedimentary filling, and their petroleum geology. Emphasis is put on the main factors controlling oil and gas productivity, such as the quality and maturity of potential source rocks, the presence and quality of reservoir rocks and regional seals, and the availability and expected structural style of traps. As many as nine sedimentary basins are distinguished on the shelf of East Siberia. Two of the basins, South Laptev and Novosibirsk, are filled with Paleozoic-Mesozoic rocks. Others are filled with Cretaceous and Tetiary sediments. The most probable amounts of undiscovered petroleum resources in all these offshore basins are estimated at 5.8 x 10^9 bbl of oil and 70.9 x 10^{12} ft^3 of gas. The onshore Yenisey-Lena basin possesses good potential (most probably 7.4 x 10^9 bbl of oil and 95.1 x 10^{12} ft^3 of gas), whereas the Indigirka-Zyryanka basin is estimated to be rather poor (0.5 x 10^9 bbl and 9.5 x 10^{12} ft^3). The offshore South Kara subbasin is a continuation of the West Siberian basin. It is potentially very rich, with most probable undiscovered resources of 5.7 x 10^9 bbl of oil and 163.8 x 10^{12} ft^3 of gas. Basins of the East Greenland shelf probably contain undiscovered resources of 4.3 x 10^9 bbl of oil and 24.1 x 10^{12} ft^3 of gas. 107 references, 21 figures, 6 tables.

27845 (NMERDI—2-68-3308) Geologic investigations in support of a proposed carbon dioxide miscible flood in the MCA unit Maljamar-Grayburg/San Andres Pool, Lea County, New Mexico. Final report. Foster, R.W. (New Mexico Inst. of Mining and Technology, Socorro (USA). New Mexico Petroleum Recovery Research Center). Mar 1984. 340p. NTIS, PC A15/MF A01. Order Number DE84901074.

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Presented are the results of a detailed geologic study of the principal oil-bearing intervals within the Grayburg and San Andres Formations at the MCA Unit of the Maljamar Field. The work includes an interpretation of the depositional environment for selected intervals as determined from core and thinsection studies. The conclusion is that the sediments were deposited along a prograding shore line and represent near shore marine, intertidal, and supratidal deposits. An evaluation of porosity and permeability as related to core interpretations led to the conclusion that conditions favorable for the accumulation of oil were almost entirely restricted to nearshore marine deposits. Intertidal and supratidal rocks were not favorable for the development of effective porosity. Although many types of porosity are present, the most important in both the dolomite and sandstone reservoirs is secondary vuggy porosity. The Grayburg includes at least 14 sandstone reservoirs and the San Andres numerous dolomite zones and one sandstone interval. The distribution and effective porosity of important zones as related to the carbon dioxide flood are shown in maps and cross sections. 14 references, 64 figures, 11 tables.

0203 Drilling And Production

REFER ALSO TO CITATION(S) 27845, 27865, 27931, 27932, 27933, 28230

27846 (DOE/BC—84/1/SP) Federal enhanced oil recovery research: increased understanding of the 300-billion-barrel US residual oil resource and the technologies to produce it. (USDOE Bartlesville Project Office, OK (USA)). Feb 1984. 27p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE84011794.

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Domestic petroleum production is on a path toward steep decline despite much higher oil prices. This decline is detrimental to national interests for the following reasons: the domestic petroleum industry is showing signs of following steel, consumer electronics, and automobiles toward reliance on foreign supplies; increased imports will reduce domestic employment, productivity, and economic activity; increased imports will reduce federal and state tax bases, as other nations capture these economic benefits; increased imports will exacerbate balance of payments deficits; increased imports will increase vulnerability to import disruptions and international pressures from exporting countries and our trading partners; and our national economic and military security demands a significant level of domestic petroleum production. Higher oil prices have increased domestic exploration and prolonged life of marginal wells, but neither of these has nor can significantly offset the decline in petroleum production. Three hundred billion barrels of known residual oil will be abandoned in discovered US reservoirs after conventional production techniques have been exhausted. Residual oil is trapped by interfacial or viscous forces, or lies in parts of the reservoir that cannot be swept by usual means. Enhanced oil recovery (EOR) represents a number of processes designed to produce residual oil. Future EOR production is highly uncertain, but EOR has the potential to maintain US oil production near its current level, within current and near-term prices. EOR is potentially the least-cost option for maintaining domestic production. 16 references, 20 figures, 1 table.

27847 (DOE/BC/10361—39) Fatigue studies of drill pipe immersed in drilling mud with H_2S and CO_2. Final report, October 1, 1980-July 31, 1983. Hendrickson, J.R. (Tulsa Univ., OK (USA)). 1984. Contract AS19-80BC10361. 88p. NTIS, PC A05/MF A01; GPO Dep. Order Number DE84012083.

This report contains results of a test program concerning corrosion fatigue studies of drill pipe immersed in circulating drilling mud containing hydrogen sulfide. The work was performed under controlled conditions in a laboratory at The University of Tulsa, using a test cell specifically designed and built for this program. The facility used real drilling mud circulating, in a closed airtight system, over dynamically-stressed drill pipe specimens. A laboratory computer was used to automatically collect data during the tests, which lasted up to 18 days. No significant difference was found in the performance of normalized-and-tempered vs quenched-and-tempered Grade E drill pipe, but quenched-and-tempered Grade X pipe showed exceptionally desirable qualities. Higher-strength pipe proved to be susceptible to rapid failure via hydrogen embrittlement, as expected. But chemical control of the drilling mud resulted in significant improvement in performance. Corrosion coupons made from five different grades of pipe gave nearly identical corrosion rates under a given set of conditions, but in all cases there was a significant dependence of corrosion rate on temperature. No significant degradation of performance was found when a simple water-based non-dispersed mud was replaced by a dispersed water-based mud containing lignosulfonate. Two precursor effects were found which identify poisoning of steel by hydrogen sulfide. Parameters affected were the stiffness of the steel, and its bulk electrical resistance. The second of these two effects shows some promise for use in the field as a test to identify bad pipe, possibly before cracks begin to grow. 17 references, 53 figures, 32 tables.

27848 **(NP—4770256) Oil and gas from the sea.** (Deutsche Shell A.G., Hamburg (Germany, F.R.). Abt. Information und Presse; Shell Austria A.G., Vienna; Shell Switzerland, Zurich). Mar 1983. 12p. (In German). NTIS (US Sales Only), PC A02/MF A01. Order Number DE84770256.

The increasing importance of the petroleum and gas production from the sea bed is analysed and some presently developing plants and techniques to reach greater sea depths are presented. The developments in this field are e.g. the use of computers to analyse complex seismic events, improved exploration techniques, swimming conveying plants and probes and collecting stations on the sea bed.

27849 **(PB—84-151695) Determination of propped fracture length by detection of injected magnetic material with surface superconducting magnetometers. Annual report, Feb 82-Jan 83.** Wood, M.D.; Parkin, C.W. (Hunter Geophysics, Mountain View, CA (USA)). Feb 1983. 96p. NTIS, PC A05/MF A01.

During the first year of the SQUID magnetometer proppant mapping project, all hardware and software were developed and tested, and a surface array of seven magnetometers was deployed in two field tests at the Amoco Catoosa research site near Tulsa. Accomplishments leading to the Catoosa tests included development of theoretical solutions of the magnetic fields for a variety of magnetically tagged proppant geometries and dimensions; scale modeling using proppant tag materials; extension of tiltmeter real-time analysis to support the magnetometer field tests; and two sets of field shakedown experiments to pretest the magnetometers and data acquisition hardware and software. In the second set of Catoosa tests, after all modifications of the magnetometers had been completed, the SQUID data were analyzed to successfully map a shallow, magnetically tagged proppant in a horizontal fracture.

0204 Processing

REFER ALSO TO CITATION(S) 28963

27850 **(DOE/BC/10450—1) Specific heavy oil processing market study. Final report.** (Texas Consultants, Inc., Houston (USA)). Jun 1984. Contract AC19-81BC10450. 102p. NTIS, PC A06/MF A01; GPO Dep. Order Number DE84011592.

The market potential for two not-yet-commercialized, proprietary processes for upgrading heavy oil was evaluated. Dynacracking (TM) of Hydrocarbon Research Inc. (HRI) and Aurabon of UOP Process Division (UOP), including an integrated commercial hydrotreating unit were the processes studied. The report concludes that while a large market for Heavy Oil Processing (HOP) units was originally forecast as the result of the shift to heavier crudes by US refiners under a given demand slate and refinery configuration, this market has either eroded due to massive demand shifts (both in volumetric and relative product mix terms) or largely been satisfied on an accelerated basis (due to downstream restructuring pressures) by units already constructed or under firm commitment utilizing other HOP technology. Dynacracking or Aurabon does not appear to offer the substantial economic advantage needed to replace other HOP units already committed. However, additional demands for HOP units couold arise, particularly on a regional basis, if significant additional foreign or domestic sources of heavy crude are introduced into the supply picture or the demand structure moves dramatically away from that currently foreseen by the EIA. Expected profit margins were calculated for both processes, allowing $2/barrel extra credit to the Aurabon products because of their higher quality. Both processes appear to produce about the same fraction of vacuum bottoms when processing the same crude. Dynacracking produces a higher proportion of naphtha and Aurabon produces substantially more heavy distillate. This report is not intended to serve as a basis of selecting either process for a particular installation. 10 references, 7 figures, 29 tables.

27851 **(PB—84-166123) Trends in residual fuel oil demand and conversion capacities in Western Europe - impact on sulphur emissions.** Bennett, R.J.; Browning, R.J.; Crossman, J.D.; Hamann, R.; Pesneau, M. (Concawe, The Hague (Netherlands)). 1984. 36p. (CONCAWE—14/83). NTIS, PC AE04/MF E01.

The report examines trends in the Western European oil refining industry, over the period 1980-90, in terms of existing and planned capacity for the conversion (upgrading) of the heavy portion of the crude. The purpose is to assess if there will be a need for desulphurization of residual fuel oil to meet the anticipated market demand, bearing in mind possible future legislative and technical requirements governing sulphur contents. The demand forecast developed shows that, while overall European energy usage will increase, there will be a decrease in inland heavy fuel oil demand and, consequently, a halving of sulphur emissions resulting from fuel oil combustion. The study indicates that the oil refining industry will be able to accomodate these trends using available crude oil supplies and existing or planned conversion capacity. It concludes that there is neither incentive nor requirement to install facilities for direct desulphurization of residues as an independent process in the foreseeable future.

27852 **Sulfiding of cobalt molybdate catalysts: characterization by Raman spectroscopy.** Schrader, G.L.; Cheng, C.P. (Ames Lab., IA). *Journal of Catalysis;* **85**: No. 2, 488-498(Feb 1984).

In situ laser Raman spectroscopic studies of the sulfiding of cobalt molybdate hydrodesulfurization catalysts were performed. Sulfiding in 10% H_2S/H_2 at 400°C resulted in the formation of stable MoS_2 structures after 2h. However, the Raman spectra indicated that small crystallites or surface layers of perhaps distorted MoS_2 were present. Stepwise sulfiding of samples to 150, 250, and 350°C permitted intermediate stages of sulfiding to be examined. Differences were observed for the relative rates of reduction versus sulfur incorporation for $CoMoO_4$, Co_3O_4, MoO_3, and aggregated or polymeric molybdate phases. Cobalt tended to increase the extent of reduction of the catalyst. A previously described model is extended to include the role of cobalt.

0206 Health And Safety

REFER ALSO TO CITATION(S) 27865, 29501

0207 Marketing And Economics

REFER ALSO TO CITATION(S) 27846, 27850, 27851

27853 **(DOE/EIA—0035(84/02)) Monthly energy review, February 1984.** (USDOE Energy Information Administration, Washington, DC. Office of Energy Markets and End Use). May 1984. 118p. NTIS, PC A06/MF A01; 1 - GPO; GPO Dep. Order Number DE84012531.

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Current data on production, consumption, stocks, imports, exports, and prices of principal energy commodities in the US are presented. Also included are data on international production of crude oil, consumption of petroleum products, petroleum stocks, and production of electric power from nuclear facilities.

27854 **(DOE/EIA—0109(84/03)) Petroleum supply monthly, March 1984.** (USDOE Energy Information Administration, Washington, DC). May 1984. 86p. NTIS, PC A05/MF A01; 1 - GPO; GPO Dep. Order Number DE84011807.

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Statistics are summarized through April 1984 and detailed for March 1984. 12 figures, 29 tables.

27855 **(DOE/EIA—0214(82)) State energy data report. Consumption estimates, 1960-1982.** (USDOE Energy Information Administration, Washington, DC. Office of Energy Markets and End Use). May 1984. 684p. NTIS, PC A99/MF A01 - GPO; GPO Dep. Order Number DE84011599.

The State Energy Data Report (SEDR) is the published output from the State Energy Data System (SEDS) maintained and operated by the Energy Information Administration (EIA). SEDS is a system for estimating the consumption of energy by major end-use sectors (residential, commercial, industrial, transportation, and electric utilities) annually by state. The goal in maintaining SEDS is to produce long-term historical trends of estimated end-use consumption by state, defined as consistently as possible. SEDS exists for two principal reasons: (1) to provide state energy consumption estimates to the government, policymakers, and the public; and (2) to provide the historical series necessary to EIA's energy models. SEDS presently provides estimates of energy consumption by principal energy sources, by major end-use sectors, by state, for a 23-year period. Reliable state energy consumption series rarely exist, especially as series that are consistent over a long period. Estimates and assumptions must be applied in order to fill data gaps and to maintain definitional consistency over time. SEDS incorporates the most consistent series and procedures possible, but users of this report (and of the public use tape of the system) should recognize limitations of such a system due to changing and inadequate data sources. The consumption estimates reported in SEDS are based on a variety of surrogate measures. The measures were selected principally on the basis of availability, applicability as an indicator of consumption, continuity over time, and consistency in maintaining the integrity of interrelated data of the various energy sources.

27856 **(DOE/EIA—0380(84/03)) Petroleum Marketing Monthly, March 1984.** (USDOE Energy Information Administration, Washington, DC. Office of Oil and Gas). Jun 1984. 123p. NTIS, PC A06/MF A01; 1 - GPO; GPO Dep. Order Number DE84012484.

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The Petroleum Marketing Monthly is prepared by the Petroleum Marketing Division, Office of Oil and Gas, Energy Information Administration. The Petroleum Marketing Monthly is designed to give information and statistical data about a variety of petroleum products, including motor gasoline, distillates, residuals, jet fuel, kerosene, and propane. The publication provides petroleum products sales statistics for use by industry, government, and private sector analysts, educational institutions, and consumers. 12 figures, 54 tables.

27857 **(DOE/OR/21400—T19) Development of sampling frame of distillate and residual fuel oil dealers and sample selection. Final project status briefing .** Flanagan, D. (Oak Ridge National Lab., TN (USA)). 5 Apr 1983. Contract AC05-84OR21400. 37p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE84011642.

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Data collection forms are presented with compiled responses from distillate and residual fuel oil dealers relative to design for sampling marketing activity.

27858 **(NP—4770263) Crude oil processing as a problem of operative decisions in petroleum industry.** Zimmermann, R. (Koeln Univ. (Germany, F.R.). Wirtschafts- und Sozialwissenschaftliche Fakultaet). 23 Jul 1982. 296p. (In German). NTIS (US Sales Only), PC A13/MF A01. Order Number DE84770263.

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While the previous decisions of the petroleum industries had been guided by the maximization of short-term profits this thesis investigates what effective goals there are in petroleum industry with regard to crude oil and what effects these goals have on the economic result of crude oil processing and decisionmaking. The calculation methods developed for this problem are described. The object of investigation is limited to the determining factors, the relations between them and the alternatives considered within the target system of the investigation in a short-term process of decision. Some theoretical approaches are discussed and finally the effects of the most important empirical restrictions are investigated. Thus the whole range of margins for decisions is presented. In the end, the theoretical model of the problem is compared with the empirical (inquiry of oil companies) behaviour in the activities of the petroleum industries in the F.R. of Germany, so that, eventually, some general theses on the decisive behaviour of the German petroleum companies in crude oil utilization can be derived.

27859 **(NP—4901235) Arctic summary report update, September 1983.** Deis, J.L.; Pierson, R. (Rogers, Golden and Halpern, Inc., Philadelphia, PA (USA)). Sep 1983. 65p. OCS Information Program, Minerals Management Service, 12203 Sunrise Valley Dr., MS 640, Reston, VA 22091. Order Number DE84901235.

This Arctic Summary Report Update provides information about oil and gas activities and their onshore effects in the Arctic Subregion for the period January 1983 through September 1983. The report summarizes (1) exploration and development activities resulting from two Arctic Federal offshore lease sales, (2) future Arctic Federal offshore lease offerings, (3) oil-and-gas exploration of the National Petroleum Reserve in Alaska and the Alaska National Wildlife Refuge, (4) the results of the State of Alaska Lease Sale 39, (5) activities on Alaska's other leased lands in the Arctic, (6) existing and proposed oil and gas transportation systems, (7) oil and gas production facilities, (8) new offshore-related studies, and (9) issues related to the export of Alaska oil. 64 references, 6 figures, 4 tables.

27860 **(NP—4901236) Gulf of Mexico index, September 1982-July 1983.** Collignon, M.A. (Rogers, Golden and Halpern, Inc., Philadelphia, PA (USA)). 1983. 127p. OCS Information Program, Minerals Management Service, 12203 Sunrise Valley Drive, Reston, VA 22091. Order Number DE84901236.

The Outer Continental Shelf (OCS) Information Program prepares regional indexes that list relevant, actual, or proposed programs, plans, reports, environmental impact statements, and other lease offering information. In this index chapter 1 describes the offshore leasing process from a national perspective and discusses the 5-year leasing program. Information on the July 1982 final 5-year OCS oil-and-gas leasing schedule, which is based on a streamlined leasing process to expedite offshore oil-and-gas exploration and development, is also presented. Chapter 2 chronicles the oil- and gas-related history of the Gulf of Mexico Region from 1978 to the present. Chapter 3 describes the steps in the prelease and postlease process. It also includes the new prelease procedures, such as the Call for Information and Area Identification. Relevant documents produced from September 1982 through July 1983 are listed by lease sale or offering for each step. Chapter 4 reports on programs of the MMS that support the offshore leasing process. The appendixes include directories of federal and state offshore-related contacts and other information pertinent to the offshore leasing process. 6 figures, 7 tables.

27861 **(NP—4901237) Mid-Atlantic summary report.** Kurtz, A.S.; Deis, J.L. (Rogers, Golden and Halpern, Inc., Philadelphia, PA (USA)). Oct 1983. 49p. OCS Information Program, Minerals Management Services, 12203 Sunrise Valley Dr., MS 640, Reston, VA 22091. Order Number DE84901237.

The first sale on the Mid-Atlantic Outer Continental Shelf (OCS), Lease Sale 40, Mid-Atlantic, was held in August 1976. The second Mid-Atlantic sale, Lease Sale 49, Mid-Atlantic, was held in February 1979. Exploratory drilling occurred from March 1978 through October 1981, but none of the 28 exploratory wells drilled produced commercial quantities of hydrocarbons. Lease Sale 59, Mid-Atlantic, was held in December 1981, and Shell began drilling operations on Block 587 (NJ 18-6) on August 2, 1983, in 6448 feet (1965 m) of water, a record-breaking depth. It is anticipated that three holes will be drilled during Shell's drilling program. Lease Sale RS-2, held in August 1982, resulted in the leasing of 18 additional deepwater blocks previously offered in Lease Sale 59, Mid-Atlantic. Mid-Atlantic Lease Offering (April 1983) was the first streamlined area wide lease offering on the July 1982 final 5-year OCS oil-and-gas leasing schedule. Industry interest was concentrated in the deeper waters, while little was expressed for the nearshore areas. The last Mid-Atlantic lease offering in the July 1982 final 5-year OCS leasing schedule will take place in June 1985. The Department of the Interior's most recent estimates of risked undiscovered recoverable resources in the Mid-Atlantic are 800 million barrels of oil and 5.6 trillion cubic feet of gas in 0 to 656 feet water depth, and 2.3 billion barrels of oil and 8.6 trillion cubic feet of gas in 656 to 8202 feet water depth. These are resources that can be

extracted economically with existing technology. Estimates of risked undiscovered resources for leased lands, which are specific to blocks that have been leased in the Mid-Atlantic, are 110 million barrels of oil and 2.2 trillion cubic feet of gas. 7 references, 3 figures, 3 tables.

27862 **(NP—4901238) Alaska index, December 1981-April 1983.** Collignon, M.A. (Rogers, Golden and Halpern, Inc., Philadelphia, PA (USA)). 1983. 77p. OCS Information Program, Minerals Management Service, 12203 Sunrise Valley Dr., MS 640, Reston, VA 22091. Order Number DE84901238.

The Outer Continental Shelf (OCS) Information Program prepares regional indexes that list relevant, actual, or proposed programs, plans, reports, environmental impact statements, and other lease-offering information. In this index chapter 1 describes the offshore leasing process from a national perspective and discusses the 5-year leasing program. Information on the July 1982 final 5-year OCS oil and gas leasing schedule, which is based on a streamlined leasing process to expedite offshore oil and gas exploration and development, is also presented. Chapter 2 chronicles the oil- and gas-related history of the Alaska Region from 1974 to the present. Chapter 3 describes the steps in the prelease and postlease process. It also includes the new prelease procedures, such as the call for information and area identification. Relevant documents produced from December 1981 through April 1983 are listed by lease sale or offering for each step. Chapter 4 reports on programs of the Minerals Management Service that support the offshore leasing process. The appendixes include directories of federal and state offshore-related contacts and other information pertinent to the leasing process. 10 figures, 2 tables.

27863 **Energy Secretary Donald Hodel tells international audience oil demand will continue to decline in industrialized nations.** Hodel, D.P. *Energy Research Reports;* **10**: No. 1, 1-4(16 Jan 1984).

From speech delivered December 8, 1983 at 4th International Oil Conference in London.

Energy Secretary Donald P. Hodel told participants at the 4th International Oil conference in London that no one really knows the future demand for oil or whether oil prices will be $29 or $80 per barrel. DOE and consumption-based forecasts do little more than indicate trends, such as the effort by industrial countries to reduce their dependence on oil and achieve a more balanced energy supply. The current OPEC prices indicate that market forces do seek equilibrium, but there is no guarantee that producing nations will not overproduce or seek new markets through price competition. Hodel projects that oil use will go down in industrial countries and increase in developing countries. He anticipates few new supplies of low-cost oil, but expects new developments in renewable energy sources by the year 2000.

0208 Waste Management

REFER ALSO TO CITATION(S) 27797, 27798

27864 **(PB—84-153899) Geopressured brine disposal. Final report, Nov 81-Sep 83.** Tatom, F.B.; Mullen, M.W.; Morel, F.M.M. (Engineering Analysis, Inc., Huntsville, AL (USA)). Dec 1983. 125p. NTIS, PC A06/MF A01.

This report covers a reveiw of current operational procedures and problems at existing Department of Energy geopressured brine disposal wells, and review available data concerning the possible accumulation of trace metals in bottom sediments in the vicinity of offshore brine disposal sites. The primary disposal option for geopressured brine is subsurface injection, with offshore submerged discharge representing the only feasible alternative. In the case of offshore disposal no experience with geopressured brine exists, but there is considerable data pertaining to the discharge of brine associated with conventional offshore oil and gas well production and with the DOE SPR program. Such data should provide a better understanding of certain environmental concerns relating primarily to the accumulation of trace metals in bottom sediments near offshore submerged diffusers.

0209 Environmental Aspects

REFER ALSO TO CITATION(S) 27864

27865 **(DOE/BC/99996—2) Methodology for modeling the migration of EOR chemicals in fresh water aquifers.** Royce, B.; Garrell, M.; Kahn, A.; Kaplan, E. (Adelphi Univ., Garden City, NY (USA). Dept. of Physics and Energy Studies; Brookhaven National Lab., Upton, NY (USA)). Nov 1983. Contract AP19-82BC99996;AC02-76CH00016. 60p. NTIS, PC A04/MF A01; 1; GPO Dep. Order Number DE84011235.

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The objective of this study is to develop a method for modeling the transport of EOR chemicals accidentally released to fresh water aquifers. Six examples involving hypothetical releases of EOR chemicals at surrogate aquifer sites are used to illustrate the application of this method. Typical injection rates and concentrations of EOR chemicals used at current or proposed projects were obtained from the literature and used as the basis for the hypothetical accidents. Four surrogate aquifer sites were selected from States where chemical flooding methods are employed. Each site is based on real hydrological data but presented in such a way to avoid identification with existing EOR fields. A significant amount of data is required to model ground water systems. The hypothetical examples help to indicate the type of data needed. The computer results illustrate that high levels of contamination are possible for many years. In addition, due to these high levels of contamination, it is possible for contaminants to migrate offsite of the EOR field. There are a variety of pathways through which EOR chemicals could be accidentally released to fresh water aquifers during normal EOR operations. There is insufficient EOR experience to date, however, to forecast risks accurately. 119 references, 10 figures, 9 tables.

27866 **(DOE/NBM—4011123) Strategic Petroleum Reserve annual environmental monitoring report, 1983.** (Petroleum Operations and Support Services, Inc., New Orleans, LA (USA)). 31 Mar 1984. 53p. NTIS, PC A04/MF A01; 1; GPO Dep. Order Number DE84011123.

Portions are illegible in microfiche products; Publication 124-84-AS001.

Progress made in the monitoring and inspection program for the Strategic Petroleum Reserve during 1983 is reported. The following sites were monitored: Bayou Choctau, Bryan Mound, St. James Terminal, Sulfur Mines, Weeks Island and West Hackberry. Discussion is presented under the headings: air quality monitoring; oil spills and NPDES compliance; and water quality monitoring. The discussion on water quality monitoring is by far the most extensive. Surface waters from the sites previously mentioned were sampled and monitored for general water quality (except for St. James Terminal where there is a lack of potentially impacted surface waters). The following parameters were measured: pH value; salinity; total suspended particulates; temperature; dissolved oxygen; biochemical oxygen demand; oil and grease; and general observations. 12 references, 6 figures. (DMC)

27867 **(DOE/PO/10850—3-Vol.1) Offshore oceanographic and environmental monitoring services for the Strategic Petroleum Reserve. Eighteen-month report for the West Hackberry Site, May 1982-November 1983. Volume I.** Hann, R.W. Jr.; Giammona, C.P.; Randall, R.E. (eds.). (Texas A and M Univ., College Station (USA). Research Foundation). Apr 1984. Contract AC96-83PO10850. 790p. NTIS, PC A99/MF A01; 1; GPO Dep. Order Number DE84011571.

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The Department of Energy's Strategic Petroleum Reserve Program began leaching the West Hackberry salt dome and discharging brine into the coastal waters OffShore of Cameron, Louisiana during mid-May 1981. This report describes the findings of a team of Texas A and M University scientists and engineers who have conducted a study to evaluate the effects of the West Hackberry brine discharge on the marine environment. The study ad-

dresses the areas of physical oceanography, analysis of the discharge plume, water and sediment quality, special pollutants, nekton, benthos, phytoplankton, zooplankton and data management. It focuses on the period from May 1, 1982 through November 14, 1983. 164 references, 249 figures, 124 tables.

27868 **(DOE/PO/10850—3-Vol.2) Offshore oceanographic and environmental monitoring services for the Strategic Petroleum Reserve. Eighteen-month report for the West Hackberry site, May 1982-November 1983. Volume II, Appendices.** Hann, R.W. Jr.; Giammona, C.P.; Randall, R.E. (eds.). (Texas A and M Univ., College Station (USA). Research Foundation). Apr 1984. Contract AC96-83PO10850. 625p. NTIS, PC A99/MF A01; 1; GPO Dep. Order Number DE84011572.

Portions are illegible in microfiche products. Original copy available until stock is exhausted.

The Department of Energy's Strategic Petroleum Reserve Program began leaching the West Hackberry salt dome and discharging brine into the coastal waters offshore of Cameron, Louisiana during mid-May 1981. This report describes the findings of a team of Texas A and M University scientists and engineers who have conducted a study to evaluate the effects of the West Hackberry brine discharge on the marine environment. The study addresses the areas of physical oceanography, analysis of the discharge plume, water and sediment quality, special pollutants, nekton, bethos, phytoplankton, zooplankton and data management. It focuses on the period from May 1, 1982 through November 14, 1983. Volume 2 contains appendices for the following: (1) supporting data for physical oceanography; (2) supporting data for brine plume measurements; (3) supporting data for water and sediment quality; (4) supporting data for special pollutant analysis; (5) supporting data for nekton investigations; (6) supporting data for phytoplankton investigations; (7) supporting data for zooplankton data; and (8) West Hackberry brine discharge data and West Hackberry raw water intake structure data. 295 figures, 160 tables.

27869 **(DOE/PO/10850—3-Vol.3) Offshore oceanographic and environmental monitoring services for the Strategic Petroleum Reserve. Eighteen-month report for the West Hackberry Site, May 1983-November 1983. Volume III, Executive Summary.** Hann, R.W. Jr.; Giammona, C.P.; Randall, R.E. (eds.). (Texas A and M Univ., College Station (USA). Research Foundation). Apr 1984. Contract AC96-83PO10850. 38p. NTIS, PC A03/MF A01; GPO Dep. Order Number DE84011573.

The Department of Energy's Strategic Petroleum Reserve Program began leaching the West Hackberry salt dome and discharging brine into the coastal waters offshore of Cameron, Louisiana during mid-May 1981. This report describes the findings of a team of Texas A and M University scientists and engineers who have conducted a study to evaluate the effects of the West Hackberry brine discharge on the marine envoronment. The study addresses the areas of physical oceanography, analysis of the discharge plume, water and sediment quality, special pollutants, nekton, benthos, phytoplankton, zooplankton and data management. It focuses on the period from May 1, 1982 through November 14, 1983. Volume 3 contains the executive summary and summaries for the following tasks: physical oceanography; brine plume; water and sediment quality; special pollutant survey; nekton; benthos; phytoplankton; and zooplankton. 1 figure.

27870 **(PB—84-164144) Response of crude oil slicks to dispersant treatment at sea, 1978 tests. Final report, Jan 78-Dec 80.** (JBF Scientific Corp., Wilmington, MA (USA)). Mar 1984. 89p. NTIS, PC A05/MF A01.

See also PB84-164151.

Four small research oil spills (3.54 cu m each) were made to compare the physical and chemical behavior of crude oils on the sea with and without dispersant treatment. Work was performed 90 km southeast of New York Harbor under a research ocean dumping permit from the U.S. Environmental Protection Agency (EPA). Each spill was made from a research vessel and was tracked by vessel and aircraft for several hrs. Two crude oils were used; one spill of each was treated with dispersant after 30 min, and one was allowed to weather naturally as an experimental control. A self-mix dispersant was sprayed on the two treated slicks from a helicopter that had been fitted with a spray system delivering droplets whose mean diameter was approximately 2 mm. More than 750 samples of background water, water under the slicks, and surface water were taken for chemical analysis. Sampling continued for 6 to 7 hr after each spill. Aerial photographs were taken, and representative photographs are presented in this report. Currents and winds were measured, leading to interpretation of physical transport of the oils. This report complements earlier work performed in 1975 and 1978.

27871 **(PB—84-164151) Response of crude oil slicks to dispersant treatment at sea, 1979 tests. Final report, Jan 79-Dec 80.** (JBF Scientific Corp., Wilmington, MA (USA)). Mar 1984. 66p. NTIS, PC A04/MF A01.

See also PB84-164144.

Four small research oil spills (3.54 cu m each) were made to compare the physical and chemical behavior of crude oils on the sea with and without dispersant treatment. Work was performed 90 km southeast of New York Harbor under a research ocean dumping permit from the U.S. Environmental Protection Agency (EPA). Each spill was made from a research vessel and was tracked by vessel and aircraft for several hr. Two crude oils were used; one spill of each was treated with dispersant after 30 min, and one was allowed to weather naturally as an experimental control. A self-mix dispersant was sprayed on the two treated slicks from a helicopter that had been fitted with a spray system delivering droplets whose mean diameter was approximately 2 mm. More than 750 samples of background water, water under the slicks, and surface water were taken for chemical analysis. Sampling continued for 6 to 7 hr after each spill. Aerial photographs were taken, and representative photographs are presented in this report. Currents and winds were measured, leading to interpretation of physical transport of the oils. This report complements earlier work performed in 1975 and 1978.

0210 Legislation And Regulation

REFER ALSO TO CITATION(S) 27857

0220 Transport, Pipelines, And Handling

REFER ALSO TO CITATION(S) 27859

0230 Properties

REFER ALSO TO CITATION(S) 27890, 28888, 28893, 28951

27872 **(NIPER—134-PPS-84/2) Aviation fuels, 1983.** Shelton, E.M.; Dickson, C.L. (National Inst. for Petroleum and Energy Research, Bartlesville, OK (USA)). Apr 1984. Contract FC01-83FE60149. 18p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE84011823.

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Properties of some aviation gasolines and aviation turbine fuels marketed in the United States during 1983 are presented in this report. The samples represented are typical 1983 production and were analyzed in the laboratories of 12 manufacturers of aviation gasolines and 18 producers of aviation turbine (jet) fuels. The data were submitted for study, calculation, and compilation under a cooperative agreement between the National Institute for Petroleum and Energy Research (NIPER), Bartlesville, Oklahoma, and the American Petroleum Institute (API). Results for properties of 34 samples of grades 80/87, 100/130, and 100LL for aviation gasolines, and 104 samples of military grades JP-4 and JP-5, and commercial type Jet A for aviation turbine fuels are included in this report.

27873 **(PB—84-152024) Impact assessment of reducing gasoline volatility. Final report.** Frederick, F.P. (Bonner and Moore Associates, Inc., Houston, TX (USA)). 30 Nov 1983. 197p. NTIS, PC A09/MF A01.

This report documents a study of the potential impacts of hydrocarbon emissions, on vehicle performance and on refining operations, investments and costs of restricting volatility of gasoline sold in California during the summer. Current volatility limits re-

quire a Reid vapor pressure of no more than 9 psia. Assessments of impacts were made for restrictions of 8, 7 and 6 psia fuels in two future situations based on 1985 and 1990 crude and product forecasts. Results cover emissions effects in terms of vehicular evaporative losses. Vehicle performance effects are defined in terms of cold start, warm-up, driveability and safety considerations. Industry-level refining costs are developed in terms of raw material, capital and operating components. Typical refining situations are also examined.

27874 **Probe microdistillation/mass spectrometry in the analysis of high-boiling petroleum distillates.** Schronk, L.R. (Texas A and M Univ., College Station); Grigsby, R.D.; Scheppele, S.E. *Analytical Chemistry;* **54**: No. 4, 748-755(Apr 1982). Contract AC19-80BC10171.

Results for a monoaromatics fraction from the 535-675°C distillate of a Wilmington, CA, crude oil demonstrate the efficacy of probe microdistillation/mass spectometry for the qualitative and quantitative analysis of mixtures containing relatively nonvolatile substances. The probe temperature was controlled by a programmer either lineraly or to maintain a constant ion current by feedback of the voltage from the ion current monitor to the programmer. Ions were produced by 70-eV and 10-eV electrons and by field ionization. Qualitatively, all three methods of ionization produced the same spectral patterns. Detectable compounds are distributed in a molecular weight range from 400 to 776 and in -Z(H) series from 8 to 30. About 90% of the fraction is comprised of compounds having -Z(H) numbers from 12 to 24. Volatility decreases with increasing molecular weight for compounds of a given hydrocarbon type but is effectively independent of -Z(H) for compounds having the same carbon number. 6 figures, 4 tables.

0240 Storage

REFER ALSO TO CITATION(S) 27867, 27868, 27869

27875 **(SAND—82-1765) Strategic Petroleum Reserve (SPR) cavern and well creep-closure tests.** Beasley, R.R.; Wallace, S.T. (Sandia National Labs., Albuquerque, NM (USA)). Apr 1984. Contract AC04-76DP00789. 46p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE84012913.

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This report briefly describes the history of West Hackberry cavern 11 and well 112, describes a creep/closure test, and presents the results of the test. At the test conditions from October 1981 through October 1983, cavern 11 produced an average of 60 barrels of brine per day. At the test conditions from March 1982 through August 1982, well 112 produced an average of 1 gallon of brine per day. 17 references, 17 figures, 2 tables.

0250 Combustion

REFER ALSO TO CITATION(S) 27827, 27828, 27829, 27830, 28708

03 NATURAL GAS

0301 Reserves

REFER ALSO TO CITATION(S) 27843, 27844

0302 Geology And Exploration

REFER ALSO TO CITATION(S) 27809, 27844

0303 Drilling, Production, And Processing

REFER ALSO TO CITATION(S) 27814, 27847, 27848, 27931, 27932, 28230

0306 Marketing And Economics

REFER ALSO TO CITATION(S) 27859, 27860, 27861, 27862

27876 **(DOE/EIA—0445(82)) United States natural gas at a glance, 1982.** (USDOE Energy Information Administration, Washington, DC. Office of Oil and Gas). 1982. 3p. NTIS, PC A02/MF A01; 1 - GPO; GPO Dep. Order Number DE84011567.

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A summary of statistical data is tabulated for: production; supply; consumption; disposition; reserves; wells; prices for residential and all other US consumers; and state production and consumption. (PSB)

27877 **Natural Gas Policy Act of 1978: four years of practice and two years to make perfect.** Morgan, R.G.; Patterson, M.P. (O'Connor and Hannan, Washington DC). *Kentucky Law Journal;* **71**: No. 1, 105-161(1983).

This article reviews the history of natural gas regulation prior to enactment of the Natural Gas Policy Act (NGPA), the specifics of the Act, the attempts of the Federal Energy Regulatory Commission to implement it, and the current administrative and congressional approaches to regulation. Three potential problems that could result from deregulation are difficulties between interstate pipelines and intrastate purchasers, the projected price spike, and a reorientation of the market. Legislative changes are likely during the next two years, but the industry must undertake most of the effort to deal with the effects of deregulation. The author foresees a slow and painful resolution of the issues. 193 references.

0307 Waste Management

REFER ALSO TO CITATION(S) 27855

27878 **(GAO/RCED—84-70) Disconnection of natural gas service to residential customers.** (General Accounting Office, Washington, DC (USA). Resources, Community and Economic Development Div.). 15 Nov 1983. 17p. General Accounting Office, P.O. Box 6015, Gaithersburg, MD 20760. Order Number DE84901117.

Information is given on: states' approaches to regulating disconnections of residential natural gas customers; residential gas service disconnections and reconnectons; and the use of heating assistance and weatherization programs by states to help avert residential natural gas disconnections. In summary, 31 of the 33 states reviewed had some type of year-round rules governing utility disconnections, and during the 1982 to 1983 winter season, 23 had additional rules providing a variety of restrictions against the disconnection of natural gas customers. With respect to disconnections and reconnections, the data obtained from the 13 utilities was inadequate to assess the extent of disconnections or reconnections. Utilities could not eliminate from the data customers who were countered as being disconnected more than once during the year, and their reconnection statistics did not reflect all households restored to service. All of the five states we visited had programs for assisting low-income households in paying fuel bills, providing both basic benefits and emergency assistance benefits for households facing disconnection.

27879 **(GAO/RCED—84-77) Natural gas price increases in Kansas City.** (General Accounting Office, Washington, DC (USA). Resources, Community and Economic Development Div.). 10 Feb 1984. 55p. General Accounting Office, P.O. Box 6015, Gaithersburg, MD 20760. Order Number DE84901119.

Report to the Honorable Thomas F. Eagleton and the Honorable Nancy L. Kasebaum, United States Senate.

Substantial recent increases in natural gas prices have focused considerable congressional and public attention on natural gas issues. To determine which factors contributed to an almost double-price increase in the Kansas City metropolitan area between January 1981 and January 1983, GAO obtained and analyzed information from the distribution company which sells gas to retail customers in Kansas City, and from that company's principal supplier. GAO found that about three quarters of the increase was due to the supplier's higher gas purchase costs; the remaining increase stemmed from operation and maintenance, taxes, depreciation, interest, return on equity, and other expenses. In April 1983, the supplier reduced its rates to the distributor, which in turn reduced its rates to retail customers. The result was a decrease of about 20 percent in the per-unit cost of gas to a residential customer.

0310 Legislation And Regulation

REFER ALSO TO CITATION(S) 27877

0320 Transport, Pipelines, And Handling

REFER ALSO TO CITATION(S) 27859

27880 **(PB—84-152834) Surface faulting and its effect on buried pipelines. Geotechnical engineering report.** McCaffrey, M.A.; O'Rourke, T.D. (Cornell Univ., Ithaca, NY (USA). School of Civil and Environmental Engineering). Nov 1983. 198p. (GER—83-10). NTIS, PC A09/MF A01.

Results are presented of a study undertaken to evaluate the ground movements associated with various types of faulting and to assess the response of pipelines to these fault movements. Fault types and the patterns and dimensions of surface ruptures that occur during an earthquake are described. Correlations are developed between surface fault rupture length, maximum displacement, and earthquake magnitude. Historic strike-slip faulting in the United States is investigated and the relation between strike-slip faults and global plate boundaries is discussed. The effects of surface faulting on gas distribution and transmission pipelines during the 1971 San Fernando earthquake are examined.

0330 Properties

27881 **(PB—84-161314) Abiogenic methane: scientific and practical considerations of its potential as an energy resource.** (National Academy of Sciences - National Research Council, Washington, DC (USA)). 8 Oct 1979. 12p. NTIS, PC A02/MF A01.

Evidence for the existence of commercial quantities of abiogenic methane has not been obtained. Although the outlook is dim for accumulations of abiogenic methane ever becoming a substantial energy resource, the report recommends funding of research devoted to field experiments and examination of existing data on the chemical and isotopic compositions of natural gas to determine if there are indications of the presence of abiogenic methane.

04 OIL SHALES AND TAR SANDS

REFER ALSO TO CITATION(S) 27842

0402 Site Geology And Hydrology

REFER ALSO TO CITATION(S) 27891

27882 **(UCID—20088) Assessment of methods of geological basin analysis for application to the Uinta and Piceance Basins.** Sweeney, J.J. (Lawrence Livermore National Lab., CA (USA)). May 1984. Contract W-7405-ENG-48. 24p. NTIS, PC A02/MF A01; GPO Dep. Order Number DE84012369.

Various methods of characterizing the physical (pressure-temperature) history of stratigraphic units in a subsiding basin are examined. Methods are divided into two groups: practical and computational. Practical methods involve interpretation of compaction and subsidence history from geophysical logs and other geologic data. The method is applied, as an example, from data for the Uinta Basin in northeastern Utah. Computational methods involve calculations simulating physical conditions for a given stratigraphy throughout the time of subsidence. The relative merits of the two methods are discussed and proposals made for initial study of the temperature-pressure history of kerogen-bearing rocks of the Uinta or Piceance Basins of northeastern Utah.

0404 Oil Production, Recovery, And Refining

REFER ALSO TO CITATION(S) 27891, 27891

27883 **(DOE/FE/60177—1571) Oil shale, tar sand, and underground coal gasification. Quarterly progress report, October-December 1983.** (Western Research Inst., Laramie, WY (USA)). Mar 1984. Contract FC21-83FE60177. 109p. NTIS, PC A06/MF A01; 1; GPO Dep. Order Number DE84009293.

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27884 **(DOE/FE/60177—1590) Postburn characterization of a geokinetics in situ oil shale retort.** Mason, G.M.; Giauque, R.D.; McWhorter, D.B. (Western Research Inst., Laramie, WY (USA)). Apr 1984. Contract FC21-83FE60177. 294p. NTIS, PC AA13/MF A01; 1; GPO Dep. Order Number DE84012285.

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Twenty postburn and two control (unburned) coreholes were drilled into a horizontal in situ oil shale retort at the Geokinetics field site, Uinta Basin, Utah. The object of the investigation was to study the mineralogic changes and trace element partitioning resulting from a true in situ burn of Green River oil shale under field conditions. Minerals were examined by X-ray diffraction and optical microscopy; while elemental determinations were performed utilizing X-ray fluorescence, neutron activation analysis, and other analytical chemical techniques. Statistical significance values were used to establish relationships between 13 minerals, oil, water, and 45 elements. The complex mineral assemblage created was a result of rapid intense heating coupled with fluctuating temperatures, gas and fluid pressure, cooled at a shallow depth, composed primarily of solid solutions of silicates plus cations, primarily Ca^{2+}, Mg^{2+}, and to a lesser degree Fe^{2+}. Distinct zones were observed which correspond to temperature thresholds that can be distinguished by increasing degrees of silicification of the carbonate rich raw oil shale. Trace element partitioning closely parallels the mineral assemblages. Leaching studies indicate an increase in soluble salts in zones in which temperatures were only adequate to retort and carbonize the oil shale, with the synthesis of insoluble minerals in the hottest, most intensely altered zones minimizing the extractability of potentially detrimental materials from the residue of in situ combustion.

27885 **(DOE/LC/10332—1582) Recovery of oil from Utah's Tar Sands. Final report, December 1, 1979-March 31, 1983.** Oblad, A.G.; Bunger, J.W.; Hanson, F.V.; Miller, J.D.; Seader, J.D. (Utah Univ., Salt Lake City (USA)). 1984. Contract AS20-80LC10332. 255p. NTIS, PC A12/MF A01; 1; GPO Dep. Order Number DE84009263.

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Work was focused in the following main areas: water assisted extraction of bitumens, quality and disposal of tailings, and raw bitumen clean-up; thermal recovery of bitumens in a fluidized-bed characterization of bitumen obtained and coked sand combustion; recovery of heat from hot burned sand; upgrading of raw bitumens from water extraction and thermally produced bitumens including in situ recovered material. This report covers in particular the following: investigation of the effect of bitumen viscosity in hot water extraction of tar sands and bitumen concentrate cleaning and a study of the use of an air sparged hydroclone in bitumen recovery; thermal recovery of bitumen from two additional Utah tar sands: Tar Sand Triangle and Whiterocks; upgrading of tar sand bitumens by the processing sequences; coking followed by hydrotreating of product and hydropyrolysis followed by hydrotreating of product; experimental and theoretical studies of a fluidized-bed pyrolysis reactor with a coked sand combination reactor with transfer of heat from the combustor to the pyrolysis reactor by means of potassium filled heat pipe.

27886 **(PNL—5055) Testing and performance of the Pacific Northwest Laboratory 6-kg retort.** Olsen, K.B.; Evans, J.C.; Girvin, D.C.; Sklarew, D.S.; Nelson, C.L. (Pacific Northwest Lab., Richland, WA (USA)). Feb 1984. Contract AC06-76RL01830. 21p. NTIS, PC A02/MF A01; GPO Dep. Order Number DE84012829.

This report describes and discusses the design, construction, calibration and operations of the Pacific Northwest Laboratory (PNL) 6-kg retort. Use of this retort will help determine the distribution and speciation of Hg, As, Se, and Cd compounds as a function of retorting parameters in shale oil, retort water, and offgas. The first test consisted of heating the oil shale to 500°C with a 100% nitrogen (N_2) sweep gas. Results of this test demonstrated that the system operates as designed; only two minor modifications were necessary to achieve satisfactory operation of the retort. 2 references, 3 figures, 1 table.

27887 **(UCRL—90156) Oil shale retorting processes: a technical overview.** Lewis, A.E.; Braun, R.L.; Diaz, J.C. (Lawrence Livermore National Lab., CA (USA)). Mar 1984. Contract W-7405-ENG-48. 18p. (CONF-8404121—5). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE84010554.

From 17. oil shale symposium; Golden, CO, USA (16 Apr 1984).

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The challenge facing the oil shale industry is to devise a simple and efficient retorting process that operates at low cost. This will require a thorough understanding of the important physical and chemical processes that occur during retorting, mathematical modeling to analyze the complex interactions, and sophisticated engineering to design a retorting process having the minimum cost. Retorting processes can be classified into two groups, one using hot gas as the heat transfer medium and one using hot solid material. We have constructed mathematical models of two generic processes from each of these groups to represent state-of-the-art processes as well as those under development. The models are based on detailed reaction kinetics, thermodynamics, and process physics. Using these models, we have calculated the process characteristics and the complete mass and energy balances for 50,000-barrel/day shale oil plants. We have made comparisons of these four processes to illustrate their advantages and disadvantages. The comparisons include retort vessel volume, heat exchange capacity, power requirements, water requirements, and waste gas volume. The results indicate no present easy choice of a best process. Oil shale process technology is neither highly developed nor mature, and substantial improvements can be expected from further research and development, and from industrial experience. The hot gas processes can be viewed as first-generation technology, and the hot solid processes, if they can be successfully developed, may be second-generation technology. 23 references, 9 figures, 4 tables.

0405 Properties And Composition

REFER ALSO TO CITATION(S) 28893, 28894

27888 **(DOE/LC/10877—1567) Indirect and direct tensile behavior of Devonian oil shales.** Chong, K.P.; Chen, J.L.; Dana, G.F.; Weber, J.A. (Wyoming Univ., Laramie (USA). Dept. of Civil Engineering). Mar 1984. Contract AS20-82LC10877. 21p. NTIS, PC A02/MF A01; GPO Dep. Order Number DE84009296.

Ultimate indirect tensile strengths of Devonian oil shales across the bedding planes is a mechanical property parameter important to predicting how oil shale will break. This is particularly important to in-situ fragmentation. The Split Cylinder Test was used to determine the indirect tensile strengths between the bedding planes. Test specimens, cored perpendicular to the bedding planes, representing oil shales of different oil yields taken from Silver Point Quad in DeKalb County, Tennessee and Friendship in Scioto County, Ohio, were subjected to the Split Cylinder Test. Linear regression equations relating ultimate tensile strength across the bedding planes to volume percent of organic matter in the rock were developed from the test data. In addition, direct tensile strengths were obtained between the bedding planes for the Tennessee oil shales. This property is important for the design of horizontal fractures in oil shales. Typical results were presented.

27889 **(DOE/LC/10900—1572) Nondestructive analysis of oil shales with PGNAA technique.** Maly, J.; Bozorgmanesh, H. (Science Applications, Inc., Palo Alto, CA (USA)). Feb 1984. Contract AC20-82LC10900. 168p. NTIS, PC A08/MF A01; 1; GPO Dep. Order Number DE84009288.

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The feasibility of nondestructive analysis of oil shales using the prompt gamma neutron activation analysis (PGNAA) technique was studied. The PGNAA technique, developed originally for continuous analysis of coal on the belt, was applied to the analysis of eight oil-shale samples, containing between 9 and 60 gallons of oil per ton and 0.8% to 3.4% hydrogen. The PGNAA technique was modified using four neutron moderation conditions: non-moderated neutrons; non-moderated and partially moderated neutrons reflected from a water box behind the source; neutrons moderated in a water box behind and in front of the source; and neutrons strongly moderated in a polyethylene block placed in front of the source and with reflected neutrons from a water box behind the source. The studied oil shales were measured in their aluminum or wooden (masonite) boxes. The obtained Ge-Li spectra were processed by LSI-11/23 computer, using the modified programs previously developed by SAI for continuous coal analysis. The results of such processing (the peak areas for several gamma lines) were corrected and plotted against the weight percent of each analyzed element (from the chemical analysis). Response curves developed for H, C, N, S, Na, Mg, Al, Si, Ti, Ca, Fe and K show generally good linear proportions of peak area to the weight percent of the element. For hydrogen determination, NMD conditions had to be used where the response curve was not linear, but followed a curve whose slope rose with hydrogen concentration. This effect is caused by improving neutron self-moderation in sample boxes of rich oil shales, as compared to poor self-moderation of neutrons in very lean oil shales. The moisture in oil shales was measured by microwave absorption technique in small masonite boxes. This method was calibrated four times using oil-shale samples mixed gradually with larger and larger amounts of water.

27890 **1-alkenes as potential indicators of sediment shale oil contamination.** Riley, R.G.; Garland, T.R.; O'Mally, M.L.; Mann, D.C.; Wildung, R.E. (Pacific Northwest Lab., Richland, WA). *Environmental Science and Technology;* **16**: 709-713(Oct 1982). Contract AC06-76RL01830.

Hydrocarbon fractions isolated from four shale oils, two petroleum oils, and one solvent-refined coal liquid product were analyzed by capillary gas chromatography/mass spectrometry for the

presence of a homologous series of 1-alkenes. Of the liquid oil products examined, only the shale oils contained the 1-alkenes. 1-Alkenes were not detected in the hydrocarbon fractions of extracts from a raw oil shale or surface sediments collected in a drainage at locations above, adjacent to, and below the Department of Energy Anvil Points Oil Shale Facility, Rifle, CO. However, 1-alkenes were detected in restored shale, sediment aggregates formed after oil transport downstream of the facility, and oil discharging from a shale pile. The absence of 1-alkenes in petroleum and a coal liquid product suggests that this class of compounds may be unique to shale oils, perhaps allowing their use as diagnostic indicators of sediments in contact with shale oils or their refined products.

0408 Marketing And Economics

REFER ALSO TO CITATION(S) 28519

0409 Waste Research And Management

REFER ALSO TO CITATION(S) 27800

27891 **(DOE/LC/10409—18) Tar sand process water control technology. Draft final report.** Kahle, R. (Stone (Ralph) and Co., Inc., Los Angeles, CA (USA)). Sep 1981. Contract AC20-80LC10409. 289p. NTIS, PC A13; 3; GPO Dep. Order Number DE84001922.

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The location, geology, reservoir and oil properties of the major tar sand deposits of the United States are described. Past and present tar sand oil recovery processes are discussed with reference to their state of development, water requirements, waste treatment, and environmental impacts on the available surface and groundwater resources in the vicinity of the giant tar sand deposits in Utah. Four of thee oil recovery processes were selected for applicability to the Utah tar sands. Based on a review of publications, manufacturers' literature, patents, and discussions with equipment suppliers complete water treatment schemes were developed for the four selected processes. Risks associated with selection of the four oil recovery processes and water treatment methods are discussed. 22 references, 65 figures, 51 tables.

27892 **(DOE/LC/10870—1568) Development of a geotechnical stabilization plan for the existing retorted shale pile, Anvil Points, Colorado. Final report.** Meade, R.B. (Army Engineer Waterways Experiment Station, Vicksburg, MS (USA). Geotechnical Lab.). Jan 1984. Contract AI20-82LC10870. 120p. NTIS, PC A06/MF A01; 1; GPO Dep. Order Number DE84009297.

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The study was intended to estimate the stability of the retorted shale pile, describe the ground-water conditions within and beneath the pile and to develop a recommended stabilization program. Ten test holes were bored through the pile. The pile materials were sampled and tested. Each of the test holes was to be used as an observation well. Chemical testing was not within the scope of work. Novel techniques were required to sample and test the hot waste shale. The pile is marginally stable, and stability may be decreasing due to combustion. The retorted shale is decomposing by combustion at temperatures of 300 to 500°C. The retorted shale will become a fine grained ash if combustion is complete. The combusting retorted shale is losing mass as a result of combustion. The retorted shale is highly erodable. The high temperatures within the pile have influenced ground-water temperatures. The ground-water regime is complex due in part to a channel realignment made in 1948 and in part to the presence of the hot pile. Three courses of action or alternatives are discussed: permit the pile to mass waste under controlled conditions; stabilize the pile in place; or move the pile to a new location.

27893 **(LBL—17019) Rapid estimation of organic nitrogen in oil shale wastewaters.** Jones, B.M.; Harris, G.J.; Daughton, C.G. (Lawrence Berkeley Lab., CA (USA); California Univ., Richmond (USA). Sanitary Engineering and Environmental Health Research Lab.). Mar 1984. Contract AC03-76SF00098. 11p. (CONF-8404121—2). NTIS, PC A02; 3; GPO Dep. Order Number DE84010801.

From 17. oil shale symposium; Golden, CO, USA (16 Apr 1984).

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Many of the characteristics of oil shale process wastewaters (e.g., malodors, color, and resistance to biotreatment) are imparted by numerous nitrogen heterocycles and aromatic amines. For the frequent performance assessment of waste treatment procsses designed to remove these nitrogenous organic compounds, a rapid and colligative measurement of organic nitrogen is essential.

0410 Enviromental Aspects

REFER ALSO TO CITATION(S) 27802, 27891, 27892

05 NUCLEAR FUELS

0501 Reserves

27894 **(INIS-mf—8379) Uranium, the world's largest energy reserve.** Roth, B.F. (Badenwerk A.G., Karlsruhe (Germany, F.R.)). 1982. 8p. (In German). NTIS (US Sales Only), PC A02/MF A01. Order Number DE84780203.

Revised version of paper presented at meeting of Kerntechnische Gesellschaft, 18 Mar 1981, Karlsruhe (Germany, F.R.).

Uranium is the only primary energy carrier which is able to substitute for the limited fossil energy sources in the long term and to give a vital contribution to their lengthening in the intermediate term. This is pointed out in this short survey. It deals with the situation of natural uranium supply in Germany, natural uranium production in the Western world, natural uranium reserves of the Western world and with the importance of uranium as an energy carrier. (UA).

0502 Exploration

27895 **(GJBX—38(83)) Data release for parts of the eastern Adel quadrangle, Oregon.** Dayvault, R.D. (Bendix Field Engineering Corp., Grand Junction, CO (USA)). Sep 1983. Contract AC07-76GJ01664. 79p. NTIS MF A01; 2; GPO Dep. Order Number DE84000421.

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This report presents data collected in the eastern Adel Quadrangle as part of the National Uranium Resource Evaluation (NURE) program conducted by Bendix Field Engineering Corporation (BFEC) for the US Department of Energy (DOE). The purpose of the investigation was to identify geologic environments favorable for uranium deposits which, under NURE guidelines, are those that could contain 100 tons or more of U_3O_8 at an average grade of at least 100 ppM. The principal focus of work in the Adel quadrangle was on the McDermitt caldera complex, most of which lies in the adjacent Vya, McDermitt, and Jordan Valley Quadrangles; however, reconnaissance investigations also were made of the Steens Mountains and Whitehorse caldera areas.

0504 Feed Processing

REFER ALSO TO CITATION(S) 27969

27896 **(PB—84-158203) Analytical methods associated with the recovery of uranium.** Dixon, K. (Council for Mineral Technology, Randburg (South Africa)). 15 Nov 1983. 44p. NTIS, PC AE04/MF E01.

This report summarizes various approaches made to the analysis of materials arising from the processing of Karoo deposits for uranium. These materials include head and residue samples, aqueous solutions and organic solvents and, finally, the precipitated cakes of the elements recovered, i.e. uranium, molybdenum, and arsenic. Analysis was required for these elements and also vanadium, carbon, sulphur, and carbonate in the head and residue samples. The methods used include combustion methods for carbon, sulphur, and carbonate, and atomic-absorption, X-ray-fluorescence, and emission methods for the other analytes. The accuracy of the analysis is within 10 per cent.

0505 Enrichment

27897 **(GAO/RCED—84-76) Lost DOE sales to the secondary enriched uranium market have resulted in reduced revenues.** Peach, J.D. (General Accounting Office, Washington, DC (USA). Resources, Community and Economic Development Div.). 26 Jan 1984. 9p. General Accounting Office, P.O. Box 6015, Gaithersburg, MD 20760. Order Number DE84901121.

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The effect of the secondary enriched uranium market on DOE's sales and revenues under existing contracts for fiscal years 1984 through 1988 was addressed. DOE records which identified contracted deliveries of enriched uranium that had been terminated by customers and the amounts of enriched uranium those customers purchased from the secondary market were reviewed. DOE reports, analyses, and testimony which contained information on the history and rationale for these sales losses were assessed. DOE program officials within the Office of the Deputy Assistant Secretary for Uranium Enrichment and Assessment in Germantown, Maryland, and officials from five firms representing utilities interested in buying or selling surplus enriched uranium on the secondary market were interviewed. These firms are New York Nuclear Corporation, Nuexco, Nukem, Swuco, and Ugusa.

27898 **(INIS-BR—99) Isotope separation by rotating plasmas.** Nicoli, C. (Instituto Militar de Engenharia, Rio de Janeiro (Brazil)). Feb 1982. 158p. (In Portuguese). NTIS (US Sales Only), PC A08/MF A01. Order Number DE84780164.

A steady-state model of a fully ionized plasma column in a concentric cylindrical electrodes structures is proposed to study the plasma separation properties of its singly ionized ionic species, composed of two isotopes of the element. In this model (a one-fluid model) rotation is imparted to the plasma column through the J (vector) x B (vector) interaction. Radial pressure balance is mainly between the radial component of the J (vector) x B (vector) force and the pressure gradient plus centrifugal force and the azimutal component of the J (vector) x B (vector) force is balanced purely by viscous force. A pressure tensor [31] describes the viscoys effect and the heat balance provides an equation for temperature. A uranium gas with is two main isotopes (U^{235} and U^{238}) was used for the ionic component of the plasma. The computing code to solve the resulting, system of equations in tems of density, temperature, and velocity as functions of the radial independent variable was set up to yield solutions satisfying null velocity conditions on both boundaries (inner and outer electrodes). (M.A.F.).

27899 **(K/PS—449) UF_6 cylinder homogenization study: Experimental result with a 10-ton cylinder.** Park, S.H. (Oak Ridge Gaseous Diffusion Plant, TN (USA)). May 1983. Contract AC05-84OT21400. 25p. NTIS, PC A02/MF A01; GPO Dep. Order Number DE84011589.

The UF_6 cylinder homogenization process has been investigated experimentally with a 10-ton cylinder. A specially modified cylinder equipped with sampling probes and temperature sensors was filled with essentially equal amounts of three different assay materials. The cylinder was then heated in an autoclave with saturated steam for 13 hours. Samples were drawn from each of four sampling ports for 11 hours. Temperature measurements indicated that solid UF_6 existed in the cylinder for 5 hours, and the assay mixing pattern during this period was fairly localized. Large scale mixing of the different assay materials followed after the complete melt down of the solid UF_6 due to a large temperature gradient in the liquid. The temperature gradient decreased to less than 1°F/ft after 11 hours of heating; henceforth, the mixing motion by liquid convection practically ceased. The test results indicated that the variance of assay samples, at any given time, were never smaller than the variance of the spectrometer measurements during the entire test period and, hence, it can be concluded that the cylinder never achieved absolute homogeneity. The definition or requirements for homogeneity of a UF_6 is beyond the scope of this report; however, since the analysis for assay of a cylinder is considered to be accurate to 0.1%, this would seem to be a minimum requirement. The assays at the four ports were within 0.1% of each other after 8.5 hours of heating and within 0.05% after 11 hours of heating. Two liquid samples were taken at the end of the test through the valve. The average assay value of these was 2.1743% ^{235}U which was 0.02% off from the theoretically calculated value.

27900 **(K/PS—452) Temperature measurement and sampling probes for the UF_6 homogenization study.** Branam, D.A. (Oak Ridge Gaseous Diffusion Plant, TN (USA)). Oct 1983. Contract AC05-84OR21400. 22p. NTIS, PC A02/MF A01; GPO Dep. Order Number DE84011908.

Special multipurpose probes have been designed and fabricated to facilitate temperature measurement and sample withdrawal during an experiment which was conducted to examine the UF_6 assay homogenization process within a standard 10-ton UF_6 cylinder during a typical cylinder heating cycle in a steam autoclave. Three special probes were mounted in the test cylinder and used to provide 15 temperature measurement points and to collect UF_6 samples at 4 of the 15 points. This report discusses the design and construction of these probes and how the various design criteria were met.

0507 Fuels Production And Properties

REFER ALSO TO CITATION(S) 28309, 28310

27901 **(HEDL-SA—2998-FP) Nuclear fuel and cladding transient testing.** Mohr, C.L. (Hanford Engineering Development Lab., Richland, WA (USA)). 1983. Contract AC06-76FF02170. 22p. (CONF-830805—95). NTIS, PC A02; 3; GPO Dep. Order Number DE84010321.

From 7. international conference on structural mechanics in reactor technology; Chicago, IL, USA (22 Aug 1983).

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The Hot Cell capability at HEDL provides an optimum trade-off to in-reactor testing by allowing highly irradiated fuel and cladding with high fission product inventories to be tested under controlled transient conditions. The capability covers a series of cladding transient test concepts ranging from transient pressurization tests, constant strain rate tests, and displacement controlled tests. In addition, a series of fission product release and transport tests are also available which can provide source term related data on identification, release and transport mechanisms of individual chemical species and compounds. Also included are a series of fuel deformation test systems to evaluate the volume changes on melting and the transient deformation rates of UO_2 and mixed oxides at temperature up to 3000°C.

0508 Spent Fuels Reprocessing

REFER ALSO TO CITATION(S) 27901, 28858

27902 **(CONF-840413—3) Advancement of remote systems technology: past perspectives and future plans.** Hamel, W.R.; Feldman, M.J. (Oak Ridge National Lab., TN (USA)). Apr 1984. Contract AC05-84OR21400. 41p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE84011460.

From Topical meeting on robotics and remote handling in hostile environments; Gatlinburg, TN, USA (23 Apr 1984).

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In the Consolidated Fuel Reprocessing Program at the Oak Ridge National Laboratory, a comprehensive remote systems devel-

opment program has existed for the past five years. The new remote technology under development is expected to significantly improve remote operations by extending the range of admissible remote tasks and increasing remote work efficiency. The motivation and justification for the program are discussed by surveying the 40 years of remote operating experience which exists and considering the essential features of various old and new philosophies which have been, or are being, used in remote engineering. A future direction based upon the Remotex concept is explained, and recent progress in the development of an advanced servomanipulator-based maintenance concept is summarized to show that a new generation of remote systems capability is feasible through advanced technology. 20 references, 10 figures, 1 table.

27903 **(CONF-840413—4) Automatic camera tracking for remote manipulators.** Stoughton, R.S.; Martin, H.L.; Bentz, R.R. (Tennessee Univ., Knoxville (USA); Oak Ridge National Lab., TN (USA)). Apr 1984. Contract AC05-84OR21400. 28p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE84011455.

From Topical meeting on robotics and remote handling in hostile environments; Gatlinburg, TN, USA (23 Apr 1984).

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The problem of automatic camera tracking of mobile objects is addressed with specific reference to remote manipulators and using either fixed or mobile cameras. The technique uses a kinematic approach employing 4 x 4 coordinate transformation matrices to solve for the needed camera PAN and TILT angles. No vision feedback systems are used, as the required input data are obtained entirely from position sensors from the manipulator and the camera-positioning system. All hardware requirements are generally satisfied by currently available remote manipulator systems with a supervisory computer. The system discussed here implements linear plus on/off (bang-bang) closed-loop control with a $+-2^{\circ}$ deadband. The deadband area is desirable to avoid operator seasickness caused by continuous camera movement. Programming considerations for camera control, including operator interface options, are discussed. The example problem presented is based on an actual implementation using a PDP 11/34 computer, a TeleOperator Systems SM-229 manipulator, and an Oak Ridge National Laboratory (ORNL) camera-positioning system. 3 references, 6 figures, 2 tables.

27904 **(CONF-840413—5) Control and electronic subsystems for the advanced servomanipulator.** Martin, H.L.; Hamel, W.R.; Killough, S.M.; Spille, R.F. (Oak Ridge National Lab., TN (USA)). Apr 1984. Contract AC05-84OR21400. 25p. NTIS, PC A02; 3; GPO Dep. Order Number DE84011646.

From Topical meeting on robotics and remote handling in hostile environments; Gatlinburg, TN, USA (23 Apr 1984).

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The advanced servomanipulator (ASM) represents a new generation of electrically driven force-reflecting manipulator systems designed to be remotely maintainable. The primary function of the control system is to maintain stable, accurate master/slave operation while providing sensitive force reflection to the operator. The control system is based upon tightly coupled distributed digital microprocessing methods. The architectural structure of the control system is outlined and is compared to the previously developed Model M-2 control system, and justification for the advances incorporated into the ASM structure are given. The various modes of operation and diagnostics are described, and throughput requirements associated with joint servo-control and counterbalancing are discussed. The fundamental elements of the control system are reviewed, including the processor selection (Motorola MC68000) and the language (FORTH). The purpose of this document is to review the design decisions and the resulting design selections to serve as a base for future improvements. Three main areas will be covered: (1) system overview; (2) hardware implementation; and (3) software partitioning. Each area will address the specifics of the selected equipment or the functional requirements of the control method.

27905 **(CONF-840413—7) Control software architecture and operating modes of the Model M-2 maintenance system.** Satterlee, P.E. Jr.; Martin, H.L.; Herndon, J.N. (Oak Ridge National Lab., TN (USA)). Apr 1984. Contract AC05-84OR21400. 24p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE84011459.

From Topical meeting on robotics and remote handling in hostile environments; Gatlinburg, TN, USA (23 Apr 1984).

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The Model M-2 maintenance system is the first completely digitally controlled servomanipulator. The M-2 system allows dexterous operations to be performed remotely using bilateral force-reflecting master/slave techniques, and its integrated operator interface takes advantage of touch-screen-driven menus to allow selection of all possible operating modes. The control system hardware for this system has been described previously. This paper describes the architecture of the overall control system. The system's various modes of operation are identified, the software implementation of each is described, system diagnostic routines are described, and highlights of the computer-augmented operator interface are discussed. 3 references, 5 figures.

27906 **(CONF-840413—8) Lighting for remote viewing systems.** Draper, J.V. (Clarke Ambrose, Inc., Knoxville, TN (USA)). 1984. Contract AC05-84OR21400. 11p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE84011465.

From Topical meeting on robotics and remote handling in hostile environments; Gatlinburg, TN, USA (23 Apr 1984).

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Scenes viewed by television do not provide the same channels of information for judgement of distances as scenes viewed directly, since television eliminates or degrades several depth perception cues. However, it may be possible to improve depth perception of televised scenes by enhancing the information available through depth cues that are available from lighting. A literature survey and expert opinions were integrated to design a remote lighting arrangement which could enhance depth perception of operators performing remote handling operations. This paper describes the lighting arrangement and discusses some of its advantages and disadvantages. 10 references, 2 figures.

27907 **(CONF-840413—10) Advanced remotely maintainable force-reflecting servomanipulator concept.** Kuban, D.P.; Martin, H.L. (Oak Ridge National Lab., TN (USA)). 1984. Contract AC05-84OR21400. 23p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE84011634.

From Topical meeting on robotics and remote handling in hostile environments; Gatlinburg, TN, USA (23 Apr 1984).

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A remotely maintainable force-reflecting servomanipulator concept is being developed at the Oak Ridge National Laboratory as part of the Consolidated Fuel Reprocessing Program. This new manipulator addresses requirements of advanced nuclear fuel reprocessing with emphasis on force reflection, remote maintainability, reliability, radiation tolerance, and corrosion resistance. The advanced servomanipulator is uniquely subdivided into remotely replaceable modules which will permit in situ manipulator repair by spare module replacement. Manipulator modularization and increased reliability are accomplished through a force transmission system that uses gears and torque tubes. Digital control algorithms and mechanical precision are used to offset the increased backlash, friction, and inertia resulting from the gear drives. This results in the first remotely maintainable force-reflecting servomanipulator in the world. 10 references, 4 figures, 1 table.

27908 **(CONF-840413—11) Dual arm master controller concept: consolidated fuel reprocessing program.** Kuban, D.P.; Perkins, G.S. (Oak Ridge National Lab., TN (USA); Jet Propulsion Lab., Pasadena, CA (USA)). Apr 1984. Contract AC05-84OR21400. 16p. NTIS, PC A02/MF A01; GPO Dep. Order Number DE84011633.

From Topical meeting on robotics and remote handling in hostile environments; Gatlinburg, TN, USA (23 Apr 1984).

The Advanced Servomanipulator (ASM) slave was designed with an anthropomorphic stance, gear/torque tube power drives, and modular construction. These features result in increased inertia,

friction, and backlash relative to tape-driven manipulators. Studies were performed which addressed the human factors design and performance trade-offs associated with corresponding master controller best suited for the ASM. The results of these studies, as well as the conceptual design of the dual arm master controller, are presented. 6 references, 3 figures.

27909 **(CONF-840413—12) Analysis of the options - rationale for servomanipulator maintenance in future reprocessing plants.** Herndon, J.N.; Hamel, W.R. (Oak Ridge National Lab., TN (USA)). Apr 1984. Contract AC05-84OR21400. 29p. NTIS, PC A03/MF A01; GPO Dep. Order Number DE84011578.

From Topical meeting on robotics and remote handling in hostile environments; Gatlinburg, TN, USA (23 Apr 1984).

The currently available maintenance systems which can be applied, in various combinations, to large-volume in-cell maintenance operations are: (1) contact, (2) overhead cranes, (3) power manipulators, (4) mechanical master/slave manipulators, and (5) servomanipulators. The requirements for reprocessing plant maintenance are reviewed, and the capabilities of remote maintenance systems are described. A basic trade-off analysis of these remote maintenance systems considering reprocessing plant requirements is given. Justification is given for selecting the overhead crane/servomanipulator-based maintenance concept as the option most desirable for future large reprocessing plant maintenance. 23 references, 6 tables.

27910 **(CONF-8404116—2) Advanced teleoperation in nuclear applications: consolidated fuel reprocessing program.** Hamel, W.R.; Feldman, M.J.; Martin, H.L. (Oak Ridge National Lab., TN (USA)). 1984. Contract AC05-84OR21400. 15p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE84011631.

From 21. space congress; Cape Kennedy, FL, USA (24 Apr 1984).

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A new generation of integrated remote maintenance systems is being developed to meet the needs of future nuclear fuel reprocessing at the Oak Ridge National Laboratory. Development activities cover all aspects of an advanced teleoperated maintenance system with particular emphasis on a new force-reflecting servomanipulator concept. The new manipulator, called the advanced servomanipulator, is microprocessor controlled and is designed to achieve force-reflection performance near that of mechanical master/slave manipulators. The advanced servomanipulator uses a gear-drive transmission which permits modularization for remote maintainability (by other advanced servomanipulators) and increases reliability. Human factors analysis has been used to develop an improved man/machine interface concept based upon colographic displays and menu-driven touch screens. Initial test and evaluation of two advanced servomanipulator slave arms and several other development components have begun. 9 references, 5 figures.

27911 **(DP—1684) Two-stage precipitation of cerium trifluoride.** Luerkens, D.W. (Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Lab.). Apr 1984. Contract AC09-76SR00001. 31p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE84012117.

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Cerium was used as a surrogate for plutonium in studies of the solubility and precipitation of the trifluoride salt. Cerium trifluoride was precipitated using a two-stage precipitation system. A series of precipitation experiments were used to identify the significant process variables affecting precipitate characteristics. A mathematical precipitation model was developed which is based on the formation of cerium fluoride complexes. The precipitation model relates all process variables, in a single equation, to a single parameter which can be used to control particle characteristics. 11 references. 9 figures, 8 tables.

27912 **(RFP—3563) Comparison of cation exchange resins for recovering americium and plutonium from chloride wastes.** Silva, R.A.; Smith, C.M.; Navratil, J.D.; Thompson, G.H. (Rockwell International Corp., Golden, CO (USA). Rocky Flats Plant). 25 Apr 1984. Contract AC04-76DP03533. 8p. NTIS, PC A02/MF A01; GPO Dep. Order Number DE84012144.

Macroreticular and microreticular cation exchange resins were compared for their capability of recovering americium and plutonium from solutions of calcium, magnesium, potassium, and sodium chlorides. Americium and plutonium breakthrough capacity and elution behavior of the resins were determined. Of the resins tested, Dowex MSC-1 was selected as the most efficient because of its favorable capacity and excellent elution behavior. Actinide eluting agents were also studied. More concentrated (9.0M) nitric acid was found to elute plutonium faster than 7.0M HNO_3 used previously, while 7.0M HNO_3-0.1M $NANO_2$ eluted americium fastest.

27913 **(RFP—3614) Plutonium and americium recovery from spent molten-salt-extraction salts with aluminum-magnesium alloys.** Cusick, M.J.; Sherwood, W.G.; Fitzpatrick, R.F. (Rockwell International Corp., Golden, CO (USA). Rocky Flats Plant). 23 Apr 1984. Contract AC04-76DP03533. 16p. NTIS, PC A02/MF A01; GPO Dep. Order Number DE84012560.

Development work was performed to determine the feasibility of removing plutonium and americium from spent molten-salt-extraction (MSE) salts using Al-Mg alloys. If the product buttons from this process are compatible with subsequent aqueous processing, the complex chloride-to-nitrate aqueous conversion step which is presently required for these salts may be eliminated. The optimum alloy composition used to treat spent 8 wt % MSE salts in the past yielded poor phase-disengagement characteristics when applied to 30 mol % salts. After a limited investigation of other alloy compositions in the Al-Mg-Pu-Am system, it was determined that the Al-Pu-Am system could yield a compatible alloy. In this system, experiments were performed to investigate the effects of plutonium loading in the alloy, excess magnesium, age of the spent salt on actinide recovery, phase disengagement, and button homogeneity. Experimental results indicate that 95 percent plutonium recoveries can be attained for fresh salts. Further development is required for backlog salts generated prior to 1981. A homogeneous product alloy, as required for aqueous processing, could not be produced.

27914 **(LA-tr—83-27) Operating range, hold-up, droplet size and axial mixing of pulsed plate columns in highly disperse and low-continuity volume flows.** Schmidt, H.; Miller, H. Translated from *KFK-Nachrichten ;* **14**: 154-165(1982). Contract W-7405-ENG-36. 36p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE84004461. DE84004461

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Operating behavior, hold-up, droplet size and axial mixing are investigated in highly disperse and slightly continuous volume flows in a pulsed plate column. The geometry of the column of 4-m length and 10-cm inside diameter was held constant. The hole shape of the column bases was changed, wherby the cylindrical, sharp-edge drilled hole is compared with the punched, nozzle-shaped hole in their effects on the fluid-dynamic behavior. In this case we varied the volume flows, the ratio of volume flows, the pulse frequency and the operating temperature. The operation was held constant for the aqueous, the organic, the continuous and the disperse phases. The objective was to demonstrate the applicability of pulsed plate columns with very large differences between the organic disperse and the aqueous continuous volume flow, to obtain design data for such columns and to perform a scale-up to industrial reprocessing plant-size. 18 references, 11 figures, 3 tables.

27915 **(LA-tr—83-29) Analysis of process signals from a reprocessing plant.** Avenhaus, R; Spannagel, G. Translated from *KFK-Nachrichten ;* **14**: 193-197(1982). Contract W-7405-ENG-36. 13p. NTIS, PC A02/MF A01; GPO Dep. Order Number DE84005000. DE84005000

Monitoring and control of complex processes as encountered primarily in modern industry, today require operators of above-average experience and ability. In the interest of a secure and continu-

ous operation it is thus necessary to seek methods which will support a process control so that the operator can recognize the reasons for malfunctions as quickly as possible. Regardless of whether the particular problems are encountered in every technical process, in the present report process steps for the planned reprocessing plant are considered. Besides the control of such a plant, a monitoring of the core material is necessary to maintain a control of the movement of fissionable materials. The test methods described also apply to this problem. 5 references, 4 figures.

0509 Transport And Storage

REFER ALSO TO CITATION(S) 27953, 27979, 27984, 27988, 28986, 28987

27916 (DOE/RL—84-1) Spent fuel storage requirements. An update of DOE/RL-83-1. (USAEC Richland Operations Office, WA). May 1984. 42p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE84011822.

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Spent fuel storage capacities at some commercial light water reactors (LWRs) are inadequate to handle projected spent fuel discharges. This report presents estimates of potential near-term requirements for additional LWR spent fuel storage capacity, based on information voluntarily supplied by utilities operating commercial nuclear power plants. These estimates provide information needed for planning the Department of Energy's (DOE) Federal Interim Storage (FIS) Program and the spent fuel research, development, and demonstration (RD and D) activities to be carried out under the DOE's Commercial Spent Fuel Management (CSFM) Program, in conjunction with the requirements of the Nuclear Waste Policy Act of 1982. This report is the latest in a series published by the DOE on LWR spent fuel storage requirements. Since the planning needs of the CSFM program focus on the near-term management of spent fuel inventories from commercial nuclear power reactors, the estimates in this report cover the ten-year period from the present through 1983. The report also assesses the possible impacts of using various concepts to reduce the requirements for additional storage capacity.

27917 (GA-A—16964) Reliability analysis of the tunnel rack and dry well monitored retrievable storage concepts. Ligon, D.M.; Jacobsen, F.K.; Taniguchi, T. (GA Technologies, Inc., San Diego, CA (USA)). Mar 1983. Contract AT03-81SF11528. 124p. NTIS, PC A06/MF A01; 1; GPO Dep. Order Number DE84011587.

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This report presents the results of a reliability analysis of the preliminary designs of the tunnel rack and open field dry well monitored retrievable storage (MRS) concepts. The study investigates the qualitative reliability of both MRS concepts and establishes the basis for a quantitative reliability evaluation program. Failure modes that potentially impact material throughput were identified for each storage concept. No failure mode was identified that would preclude either concept from performing its intended function. Owing to the preliminary design status of each concept, many of the identified failure modes could be eliminated as each design progresses. For an equivalent throughput, the dry well concept requires less equipment than the tunnel rack concept but must perform a greater number of functions and will likely be required to meet comparatively higher levels of operational reliability. 7 references, 3 figures.

27918 (GA-A—17305) CASMO: a computer program to calculate spent fuel and high-level waste transportation mileage and costs. Seth, S.S.; Young, K.A.; Harris, P.A. (GA Technologies, Inc., San Diego, CA (USA)). Oct 1983. Contract AT03-81SF11528. 109p. NTIS, PC A06; 3; GPO Dep. Order Number DE84011588.

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The CASMO computer program calculates the mileage and costs of transporting spent fuel and/or high-level wastes to various facilities in the back end of the nuclear fuel cycle. The program was specifically written to provide a tool for siting monitored retrievable storage (MRS) facilities. Three program options are described that can survey many potential sites or determine mileage and costs for specific sites. The results of CASMO are utilized to determine transportation risks and to perform a cost analysis of transporting transuranic (TRU) wastes.

27919 (GA-A—17323) Monitored retrievable storage conceptual studies: tunnel-rack. Morissette, R.P.; Ganley, J.T. (GA Technologies, Inc., San Diego, CA (USA)). Feb 1984. Contract AT03-81SF11528. 128p. NTIS, PC A07/MF A01; 1; GPO Dep. Order Number DE84011820.

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This report provides a system description and cost estimates for a tunnel-rack MRS facility. The facility description is divided into four parts: (1) the receiving and handling (R&H) area, (2) the interface facility, (3) the on-site transport system, and (4) the storage system. The storage system consists of underground tunnels containing steel storage racks, which in turn, contain spent fuel, HLW, or remote-handled-TRU canisters. Natural circulation removes decay heat through a system of ventilation tunnels. The interface facility joins the R&H area to the storage area. The on-site transport system moves material between these two areas. The MRS facility has been designed to meet handling rates of 1800 and 3000 MTU/yr. The corresponding peak inventories are 15,000 and 72,000 MTU. Three types of cases were considered, based on the material to be stored: spent fuel only; HLW and TRU waste; and HLW only. For each of these three types, a cost estimate was done for a 15,000 and a 72,000 MTU facility, resulting in six different cost estimates.

27920 (HEDL-SA—3061-FP) Radionuclide release from PWR spent fuel specimens with induced cladding defects. Wilson, C.N.; Oversby, V.M. (Hanford Engineering Development Lab., Richland, WA (USA); Lawrence Livermore National Lab., CA (USA)). Mar 1984. Contract AC06-76FF02170. 17p. (CONF-8405120—8). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE84011473.

From SPE/DOE/GRI unconventional gas recovery symposium; Pittsburgh, PA, USA (13 May 1984).

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Radionuclide releases from pressurized water reactor (PWR) spent fuel rod specimens containing various artificially induced cladding defects were compared by leach testing. The study was conducted in support of the Nevada Nuclear Waste Storage Investigations (NNWSI) Waste Package Task to evaluate the effectiveness of failed cladding as a barrier to radionuclide release. Test description and results are presented.

27921 (PNL-SA—11894) Current status of fuel degradation studies in dry storage. Johnson, A.B. Jr.; Gilbert, E.R. (Pacific Northwest Lab., Richland, WA (USA)). Jan 1984. Contract AC06-76RL01830. 25p. (CONF-840141—4). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE84011250.

From INMM seminar on spent fuel storage; Washington, DC, USA (10 Jan 1984).

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Cladding integrity is an important consideration for the dry storage licensing position for LWR fuel that is developing in the USA. There is a large body of data and experience for zircaloy-clad fuel behavior during reactor service. Also, some 15,000 zircaloy-clad rods have been emplaced in dry storage demonstrations in metal casks, drywells, silos and vaults. This paper summarizes zircaloy cladding behavior as it applies to expected dry storage scenarios. 25 references, 5 figures, 3 tables.

27922 (SAND—84-0826C) Advanced transportation system options for spent fuel and high-level waste. Allen, G.C. (Sandia National Labs., Albuquerque, NM (USA)). 1984. Contract AC04-76DP00789. 10p. (CONF-8404127—2; TTC—0491). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE84010302.

From INMM packaging and transportation seminar; Washington, DC, USA (17 Apr 1984).

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Multiple design and usage options exist for packagings to transport spent fuel and high-level waste. The purpose of this paper is to list many of these options and to review their merits. Parameters considered include cask usage and designs, vehicles, handling methods, gamma neutron shielding materials impact limiters, and truck system weight limits.

27923 **(TVA/OP/FUE—84/5) Integrated cask storage systems for storage, transportation, and disposal of spent nuclear fuel.** Hoskins, R.E. (Tennessee Valley Authority, Chattanooga (USA). Div. of Fuels). 1984. 7p. (CONF-840307—41). NTIS, PC A02/MF A01. Order Number DE84901144.

From Waste management '84; Tucson, AZ, USA (11 Mar 1984).

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From the spent fuel management systems studies that the authors have done, they have come to believe that it is essential that DOE take an integrated systems approach, with realistic consideration of uncertainties, in developing and carrying out a progressive program. Their studies indicate that a major departure from previous directions may be appropriate. The development of integrated cask systems for onsite storage, transportation, offsite storage if necessary, and perhaps use as a disposal container could completely revolutionize high-level waste management. Their analysis indicates that such systems potentially have: greater flexibility to deal with uncertainties; the lowest overall cost to ratepayers for managing nuclear waste; the lowest occupational and public radiological dose commitments; and several other desirable social and environmental attributes. 6 figures, 4 tables.

0520 Waste Management

REFER ALSO TO CITATION(S) 27917, 27919, 27923, 27972, 27973, 27974, 27976, 27979, 28277, 28384, 28385, 28791, 28792, 28835, 28840, 29273, 29275, 29300

27924 **(BMI—1983-007) Treatment and disposal of tritiated effluents. Technology and safety.** Hartmann, K.; Bruecher, H. (Bundesministerium des Innern, Bonn (Germany, F.R.)). Sep 1983. 233p. (In German). NTIS (US Sales Only), PC A11/MF A01. Order Number DE84751337.

The study on the disposal of tritiated effluents has been conducted in coordination with investigations carried out at NUKEM GmbH under the heading "Compilation of Safety-Related Data for an Industrial Disposal of Tritiated Effluents on the Basis of Large-Scale Invenstigations". The findings of this study were adopted, in particular with a view to tritium exchange rates ascertained experimentally. After some introductory remarks on the origin of tritium, its properties and its behaviour in a reprocessing plant three alternative methods for the disposal of tritiated effluents produced during reprocessing are described in the present study and compared with each other under various aspects. The study is based on the concept of a 1400 t/a reprocessing plant for LWR fuel, which annually produces 3000 m^3 of tritiated waste water with a tritium content of 6.5×10^{12} Bq/m^3 as well as a residual fission product and actinide content.

27925 **(BMI/ONWI—145) User's manual and guide to SALT3 and SALT4: two-dimensional computer codes for analysis of test-scale underground excavations for the disposal of radioactive waste in bedded salt deposits.** Lindner, E.N.; St. John, C.M.; Hart, R.D. (Minnesota Univ., Duluth (USA)). Feb 1984. Contract AC02-83CH10140. 170p. NTIS, PC A08/MF A01; 1; GPO Dep. Order Number DE84011198.

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SALT3 and SALT4 are two-dimensional analytical/displacement-discontinuity codes designed to evaluate temperatures, deformation, and stresses associated with underground disposal of radioactive waste in bedded salt. These codes were developed by the University of Minnesota for the Office of Nuclear Waste Isolation in 1979. The present documentation describes the mathematical equations of the physical system being modeled, the numerical techniques utilized, and the organization of these computer codes. The SALT3 and SALT4 codes can simulate: (a) viscoelastic behavior in pillars adjacent to excavations; (b) transversely isotropic elastic moduli such as those exhibited by bedded or stratified rock; and (c) excavation sequence. Major advantages of these codes are: (a) computational efficiency; (b) the small amount of input data required; and (c) a creep law based on laboratory experimental data for salt. The main disadvantage is that some of the assumptions in the formulation of the codes, i.e., the homogeneous elastic half-space and temperature-independent material properties, render it unsuitable for canister-scale analysis or analysis of lateral deformation of the pillars. The SALT3 and SALT4 codes can be used for parameter sensitivity analyses of two-dimensional, repository-scale, thermomechanical response in bedded salt during the excavation, operational, and post-closure phases. It is especially useful in evaluating alternative patterns and sequences of excavation or waste canister placement. SALT3 is a refinement of an earlier code, SALT, and includes a fully anelastic creep model and thermal stress routine. SALT4 is a later version, and incorporates a revised creep model which is strain-hardening.

27926 **(BMI/SRP—5002) Well completion report - dissolution zone water wells (PD-8, PD-11, PD-12, PD-13), Palo Duro Basin, Texas: unanalyzed data.** (Stone and Webster Engineering Corp., Boston, MA (USA)). Apr 1984. Contract AC02-83CH10140;AC06-76RL01830. 70p. NTIS, PC E07/MF $8.50; GPO Dep. Order Number DE84011685.

Includes 22 sheets of 24x reduction microfiche.

This report describes the drilling and testing of four dissolution zone water wells: Sawyer No. 2, Mansfield No. 2, Detten No. 2, and Harman No. 1; each in a different location in Texas. Drilling and testing were performed by Stone and Webster Engineering Corporation as a part of a nationwide program to identify potential locations for a nuclear waste repository. Stone and Webster worked under a contract with the US Department of Energy's Program Manager: Battelle Project Management Division, Office of Nuclear Waste Isolation. This report describes the drilling and testing activities actually performed (compared to the Field Test Plan), describes the problems encountered, and provides recommendations for future work. Data gathered during drilling and testing of the well are included as appendices to this report. These data are preliminary. They have been neither analyzed nor evaluated. 5 figures.

27927 **(BMI/SRP—5003) Well completion report - G. Friemel No. 1 (PD-5) well, Palo Duro Basin, Texas: unanalyzed data.** (Stone and Webster Engineering Corp., Boston, MA (USA)). May 1984. Contract AC06-76RL01830;AC02-83CH10140. 177p. NTIS, PC E09/MF A01 $6.00; 1; GPO Dep. Order Number DE84012555.

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This report provides a brief description and history of the drilling and testing program conducted at the G. Friemel No. 1 well, located in eastern Deaf Smith County about 4 miles north of Dawn, Texas. Drilling and testing were performed by Stone and Webster Engineering Corporation as a part of a nationwide program to identify potential locations for a nuclear waste repository. Figures showing site layout and final well design are provided. Testing programs are described, and stratigraphic data derived from the well are summarized. Data derived from geophysical well logs, drill-stem tests, and other testing programs are presented in the appendixes. Drilling of the well started on February 23, 1982, and was completed on March 31, 1982, at a total depth of 2710 feet. These data are preliminary. They have been neither analyzed nor evaluated.

27928 **(BMI/SRP—5004) Well completion report - Harman No. 1 (PD-8) well, Palo Duro Basin, Texas: unanalyzed data.** (Stone and Webster Engineering Corp., Boston, MA (USA)). May 1984. Contract AC02-83CH10140. 231p. NTIS, PC A11; 3; GPO Dep. Order Number DE84011891.

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This report describes the drilling and testing of Harman No. 1 well, located in north-central Swisher county, about 7 miles north of Tulia, Texas. Drilling and testing were performed by Stone and Webster Engineering Corporation as a part of a nationwide pro-

gram to identify potential locations for a nuclear waste repository. Stone and Webster worked under a contract with the US Department of Energy's Program Manager: Battelle Project Management Division, Office of Nuclear Waste Isolation. This report describes the drilling and testing activities actually performed (compared to the Field Test Plan), describes the problems encountered, and provides recommendations for future work. Data gathered during drilling and testing of the well are included as appendices to this report. Drilling of the well began July 29, 1982, and was completed September 7, 1982, when a cement plug was set between the depths of 1220 and 1400 feet. These data are preliminary. They have been neither analyzed nor evaluated. 5 figures, 4 tables.

27929 **(BMI/SRP—5005) Well completion report - Mansfield No. 1 (PD-4) well, Palo Duro Basin, Texas: unanalyzed data.** (Stone and Webster Engineering Corp., Boston, MA (USA)). May 1984. Contract AC06-76RL01830;AC02-83CH10140. 461p. NTIS, PC E16/MF $8.00; 1; GPO Dep. Order Number DE84012554.

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This report describes the drilling and testing of Mansfield No. 1 well, located in Oldham County, about 10 miles north of Vega, Texas. Drilling and testing were performed by Stone and Webster Engineering Corporation as a part of a nationwide program to identify potential locations for a nuclear waste repository. This report describes the drilling and testing activities actually performed (compared to the Field Test Plan), describes the problems encountered, and provides recommendations for future work. Data gathered during drilling and testing of the well are included as appendices to this report. Drilling of the well began October 19, 1981. Casing was installed and cemented to a total depth of 5180 feet on March 8, 1982. These data are preliminary. They have been neither analyzed nor evaluated.

27930 **(BMI/SRP—5007) Well completion report - Holtzclaw No. 1 (PD-10) well, Palo Duro Basin, Texas: unanalyzed data .** (Stone and Webster Engineering Corp., New York (USA)). May 1984. Contract AC06-76RL01830;AC02-83CH10140. 266p. NTIS, PC E12/MF $7.50; 1; GPO Dep. Order Number DE84012556.

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This report describes the drilling and testing of the Holtzclaw No. 1 well, located in south-central Randall County, approximately 2 miles north of Happy, Texas. Drilling and testing were performed by Stone and Webster Engineering Corporation as part of a nationwide program to identify potential locations for a nuclear waste repository. This report describes the drilling and testing activities actually performed (compared to the Field Test Plan), describes the problems encountered, and provides recommendations for future work. Data gathered during drilling and testing of the well are included as appendices to this report. Drilling of the well began March 1, 1983. The well was drilled to a total depth of 2884.4 feet and was capped on April 1, 1983. These data are preliminary. They have been neither analyzed nor evaluated.

27931 **(BMI/SRP—5012) Permeability data base: Palo Duro Basin - Texas, Oklahoma, and New Mexico - unanalyzed data.** (Stone and Webster Engineering Corp., New York (USA)). May 1984. Contract AC02-83CH10140;AC06-76RL01830. 108p. NTIS, PC A06/MF A01; 1; GPO Dep. Order Number DE84011278.

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This is an unanalyzed computer listing of oil and gas well data being reviewed by Stone and Webster Engineering Corporation (SWEC). This file contains well data from counties in and surrounding the Palo Duro Basin of West Texas. These data files, compiled from Petroleum Information Services (PI) prior to October, 1983, are one part of an extensive program to define the geology and geohydrology of the Palo Duro Basin. The computer listing gives the well location by county, operator name, lease name, date drilled, total depth, deepest formation penetrated, and American Petroleum Institute (API) number. These data are preliminary. They have been neither analyzed nor evaluated.

27932 **(BMI/SRP—5013) Oil and gas well data file - Palo Duro Basin, Texas and New Mexico: unanalyzed data.** (Stone and Webster Engineering Corp., Boston, MA (USA)). May 1984. Contract AC02-83CH10140. 4p. NTIS, PC E05/MF $8.00; GPO Dep. Order Number DE84011889.

Includes 20 sheets of 24x reduction microfiche.

This is an unanalyzed computer listing of oil and gas well data being reviewed by Stone and Webster Engineering Corporation (SWEC). This file contains well data from counties in and surrounding the Palo Duro Basin of West Texas. These data files, compiled from Petroleum Information Services (PI) prior to October 1983, are one part of an extensive program to define the geology and geohydrology of the Pal Duro Basin. The computer listing gives the well location by county, operator name, lease name, date drilled, total depth, deepest formation penetrated, and American Petroleum Institute (API) number. These data are preliminary. They have been neither analyzed or evaluated.

27933 **(BMI/SRP—5014) Formation pressure data file - Palo Duro Basin, Texas and New Mexico: unanalyzed data.** (Stone and Webster Engineering Corp., Boston, MA (USA)). May 1984. Contract AC02-83CH10140. 24p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE84011890.

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This is an unanalyzed computer listing of drill stem test data being reviewed by Stone and Webster Engineering Corporation (SWEC). This file contains well data from counties in and immediately surrounding the Palo Duro Basin of West Texas. These data files, compiled from Petroleum Information Services (PI) prior to October 1983, are one part of an extensive program to define the geology and geohydrology of the Palo Duro Basin. The computer listing supplies geologic, hydrologic, and formation pressure data obtained from the drill-stem tests. These data are preliminary. They have been neither analyzed nor evaluated.

27934 **(BNL—51756) Waste form development program. Annual report, October 1982-September 1983.** Colombo, P.; Kalb, P.D.; Fuhrmann, M. (Brookhaven National Lab., Upton, NY (USA)). Sep 1983. Contract AC02-76CH00016. 86p. NTIS, PC A05/MF A01; 1; GPO Dep. Order Number DE84012918.

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This report provides a summary of the work conducted for the Waste Form Development/Test Program at Brookhaven National Laboratory in FY 1983 under the sponsorship of the US Department of Energy's Low-Level Waste Management Program. The primary focus of this work is the investigation of new solidification agents which will provide improved immobilization of low-level radioactive wastes in an efficient, cost-effective manner. A working set of preliminary waste form evaluation criteria which could impact upon the movement of radionuclides in the disposal environment was developed. The selection of potential solidification agents for further investigation is described. Two thermoplastic materials, low-density polyethylene and a modified sulfur cement were chosen as primary candidates for further study. Three waste types were selected for solidification process development and waste form property evaluation studies which represent both new volume reduction wastes (dried evaporator concentrates and incinerator ash) and current problem wastes (ion exchange resins). Preliminary process development scoping studies were conducted to verify the compatibility of selected solidification agents and waste types and the potential for improved solidification. Waste loadings of 60 wt % Na_2SO_4, 25 wt % H_3BO_3, 25 wt % incinerator ash and 50 wt % dry ion exchange resin were achieved using low density polyethylene as a matrix material. Samples incorporating 65 wt % Na_2SO_4, 40 wt % H_3BO_3, 20 wt % incinerator ash and 40 wt % dry ion exchange resin were successfully solidified in modified sulfur cement. Additional improvements are expected for both matrix materials as process parameters are optimized. Several preliminary property evaluation studies were performed to provide the basis for an initial assessment of waste form acceptability. These included a two-week water immersion test and compressive load testing.

27935 **(CEA-CONF—6965) Recent progress in actinide and lanthanide solvent extraction.** Musikas, C.; Hubert, H.; Benjelloun, N.; Vitorge, P.; Bonnin, M.; Forchioni, A.; Chachaty, C. (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France)). Apr 1983. 3p. (CONF-8304147—3). NTIS (US Sales Only), PC A02/MF A01. Order Number DE84750660.

From 13. meeting on actinides; Elat, Israel (26 Apr 1983).

Work in progress on actinide solvent extraction is briefly reviewed in this paper. ^{1}H and ^{31}P NMR are used to elucidate several fundamental unsolved problems concerning organophosphorous extractants often used in actinides extraction: determination of site of dialkylthiophosphate protonation and addition of basic phosphine oxide to dibutylthiophosphoric acid dimer. Extraction of Am III and Eu from high radioactivity level wastes by tetrasubsituted methylene diamides is investigated. Trivalent actinide-lanthanide group are separated by solvent extraction using soft donor ligand complexes which are more stable. The synergism of dinonylnaphtalene sulfonic acid (HDNNS) associated with several neutral donors like TBP, TOPO, amides are examined in the trivalent and tetravalent actinide extraction.

27936 **(CONF-8404145—2) Methodology for selecting low-level radioactive waste disposal sites with application to the Oak Ridge Reservation.** Lee, D.W.; Ketelle, R.H. (Oak Ridge National Lab., TN (USA)). 1984. Contract AC05-84OR21400. 19p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE84011644.

From Energy and environment symposium on facility siting and routing; Banff, Alberta, Canada (15 Apr 1984).

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A methodology was developed to select an environmentally acceptable site for low-level radioactive waste disposal for a predetermined region of interest using prescribed site suitability requirements. The methodology provides a defensible means for identifying candidate areas within the region, candidate sites within the areas, and an environmentally preferred site from the candidate sites. This is accomplished in site screening and site characterization stages. The site screening stage relies on reconnaissance data to identify a preferred site. The site characterization stage relies on a detailed site investigation to determine site acceptability. The methodology was applied to the US Department of Energy Oak Ridge Reservation through the site screening stage. 6 references, 3 figures, 7 tables.

27937 **(DPST—80-683) Application of the single discharge slurry pump to the waste removal program.** Holtzscheiter, E.W.; Churnetski, B.V.; Looper, M.G. (Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Lab.). 24 Nov 1980. Contract AC09-76SR00001. 12p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE84012563.

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A new pump, based on technology tested with a large capacity, 35-inch-diameter quad volute slurry pump, was developed and ordered for testing at TNX. The pump has a single 3-inch discharge nozzle which can be directly retrofitted to the existing slurry pump column assembly. The single discharge pump combines the performance advantages of the larger quad volute pump with the reduced dimensions of the existing pump design. The new pump will have a cleaning radius 60% greater than the Tank 16 type pump and also operate at a lower horsepower. The pump will reduce the number of slurry pumps required for waste removal and provide a more flexible means for handling special sludge removal problems. The single discharge pump will be able to incorporate the bearing improvements required to reduce the water leak rate and will further reduce the water added to the tanks by reducing the number of pumps per tank for the waste removal program.

27938 **(DPST—81-282) Effective cleaning radius studies.** Churnetski, B.V. (Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Lab.). 19 Feb 1981. Contract AC09-76SR00001. 23p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE84012424.

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Results of testing done in the Savannah River Laboratory half tank and full tank mockup facilities using kaolin clay slurries indicate a relationship between cleaning radius and pump and slurry characteristics of the form: ECR α DV_0 (rho/tau_0) sup 1/2. This can be used to predict the slurry pump requirements for sludge removal during waste tank retirement.

27939 **(DPST—83-951) Mechanical seal program.** Lowery, G.B. (Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Lab.). 10 Nov 1983. Contract AC09-76SR00001. 9p. NTIS, PC A02/MF A01; GPO Dep. Order Number DE84012421.

The experimental plans and timing for completion of the mechanical seal program for both the slurry and transfer pumps are given. The slurry pump seal program will be completed by April 1984 with turnover of two seals in pumps to SRP Tank 15H. Transfer pump seal design will be released for plant use by May 1984. Also included are various other pump and seal related tests.

27940 **(EGG-M—19383) Licensing requirements for backfit incinerators at commercial nuclear power plants.** Dodge, R.L.; Edwards, C.W.; Wilson, B. (EG and G Idaho, Inc., Idaho Falls (USA); Gilbert/Commonwealth, Reading, PA (USA)). 1984. Contract AC07-76ID01570. 4p. (CONF-840307—37). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE84011748.

From Waste management '84; Tucson, AZ, USA (11 Mar 1984).

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This paper, and the project it reports on, examines the licensing requirements for backfit incinerators at operating power plants. Analysis was made of incinerating low-level dry radioactive waste in a backfit incinerator at an existing power plant. The operation of the incinerator has been studied from viewpoints of operator safety, consequence of system failures including worst case scenarios, and radiological impact for normal and upset conditions. Analysis showed that releases under all normal operating or upset conditions are an extremely small fraction of the applicable limits. Nuclear Regulatory Commission review concluded that the document produced as a result of this project was useful as a design guide and of value in licensing backfit incinerators. 1 table.

27941 **(EGG-M—19683) Calculating the chemical hazard of radioactive waste.** Wickham, L.E. (EG and G Idaho, Inc., Idaho Falls (USA)). Mar 1984. Contract AC07-76ID01570. 6p. (CONF-840307—35). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE84011751.

From Waste management '84; Tucson, AZ, USA (11 Mar 1984).

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Low-level radioactive wastes contain a wide variety of substances that are both radioactive and chemically hazardous. While the radioactive characteristics of these wastes have been defined, chemical components have been ignored from a management and regulatory point of view. In this paper, a methodology for comparing the hazards of various chemicals quantitatively with those of radioactive materials is presented in the form of a Waste Classification System. The system considers the hazards of materials based on intrinsic toxicity, persistence through time, availability to a human receptor, and buildup of decay or degradation products. The system has been applied to a number of materials to show its versatility. Examples are provided. 12 references, 3 tables.

27942 **(EGG-M—19883) High integrity containers: a demonstrated disposal alternative to solidification of radioactive wastes.** Schmitt, R.C.; Chapman, R.L.; Sumpter, K.C.; Reno, H.W. (EG and G Idaho, Inc., Idaho Falls (USA)). Mar 1984. Contract AC07-76ID01570. 8p. (CONF-840307—39). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE84011750.

From Waste management '84; Tucson, AZ, USA (11 Mar 1984).

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The EPICOR and Waste Research and Disposition Program at the Idaho National Engineering Laboratory developed, tested, and is using a High Integrity Container (HIC) for commercial disposal of EPICOR-II prefilter liners from the cleanup of Unit 2 of the Three Mile Island Nuclear Power Station. The HIC permits

disposal of EPICOR-II liners as Class C low-level radioactive wastes without prior solidification of resins therein. Design rationale for and testing of the HIC are discussed, and costs of using the container for disposal of EPICOR-II liners are compared with costs of solidification. It is concluded that the HIC is a cost competitive alternative to solidification for disposal of unusual types and quantities of low-level radioactive wastes. 4 references, 10 figures.

27943 **(EGG-M—19983) TMI abnormal wastes disposal options.** Ayers, A.L. Jr. (EG and G Idaho, Inc., Idaho Falls (USA)). Mar 1984. Contract AC07-76ID01570. 6p. (CONF-840307—40). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE84011746.

From Waste management '84; Tucson, AZ, USA (11 Mar 1984).

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A substantial quantity of high beta-gamma/high-TRU contaminated wastes are expected from cleanup activities of Unit 2 of the Three Mile Island Nuclear Power Station. Those wastes are not disposable because of present regulatory constraints. Therefore, they must be stored temporarily. This paper discusses three options for storage of those wastes at the Idaho National Engineering Laboratory: (1) storage in temporary storage casks; (2) underground storage in vaults; and (3) storage in silos at a hot shop. Each option is analyzed and evaluated. Also included is a discussion of future disposal strategies, which might be pursued when a suitable federal or commercial repository is built.

27944 **(NUREG/CR—2613) Identification of characteristics which influence repository design domal salt, Task 1. Final report.** Rawlings, G.; Antonnen, G.; Chamness, M.; Hofmann, R.; Roberds, W.; Soto, C.; Welden, C.; Rowe, J.; Marinelli, F.; Jones, K. (Golder Associates, Inc., Bellevue, WA (USA)). Apr 1984. 167p. NTIS, PC A08/MF A01 - GPO* $5.50. Order Number DE84901092.

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The purpose of the complete project is to provide NRC with technical assistance to enable the focused, adequate review by NRC of the aspects related to design and construction of an underground test facility and final geologic repository as presented by the Department of Energy (DOE). The study presented in this report covers the identification of characteristics which influence design and construction of a geologic repository in domal salt. This report has identified five key issues, i.e., constructibility, thermal response, mechanical response, hydrologic response, and geochemical response. This report involves both short-term (up to closure) and long-term (post closure) effects. The characteristics of domal salt and its environment are described under the headings of stratigraphic/structural, tectonic, mechanical, thermal and hydrologic. Characteristics are separated into parameters (quantified and measured) and factors (qualitative). The characteristics are then subjectively ranked by their influence on the key issues. This takes into account the availability and suitability of conservative design/construction techniques, uncertainty in model and model sensitivity to the characteristic.

27945 (ORNL—6009, pp 83-100) **Low-level Waste Research and Development Program.** Apr 1984. NTIS, PC A09/MF A01. Order Number DE84010672. TI84010672

In Environmental Sciences Division annual progress report for period ending September 30, 1983.

The Low-Level Waste (LLW) Research and Development Program integrates work directed toward waste-management activities at Oak Ridge National Laboratory (ORNL) with generic LLW studies and demonstration projects conducted for the US Department of Energy (DOE) Low-Level Waste Management Program (LLWMP). Site-specific work involves solid-waste disposal area studies of three ORNL burial grounds; vegetation management studies for burial grounds; monitoring and corrective measures analyses for inactive, liquid LLW radioactive waste sites; and waste-management-related studies of local and regional geology. Generic tasks are focused on improving shallow land burial (SLB) methods and instituting corrective measures for older sites; primary emphasis is on disposal in environments with >750 mm of annual precipitation.

27946 (ORNL—6009, pp 101-103) **Department of Energy Low-Level Waste Management Program.** Apr 1984. NTIS, PC A09/MF A01. Order Number DE84010672. TI84010672

In Environmental Sciences Division annual progress report for period ending September 30, 1983.

The overall objective of the LLWMP is to develop and promote environmentally sound techniques for safely and efficiently managing the disposal of all types of low-level wastes (LLW). Low-level wastes result from such activities as energy production, manufacturing, and the use of radioisotopes in medical and research activities. Specific program technology objectives include development of waste treatment and packaging technology; development of improved shallow land burial (SLB) technology; establishment of corrective measures for stabilizing and improving performance of existing burial grounds; identification and evaluation of alternative methods for storage and disposal of LLW that provide greater confinement than shallow land burial; and development of guidelines or standards for waste characterization, disposal, and monitoring.

27947 **(ORNL/TM—9056) Thickness of Knox Group overburden on Central Chestnut Ridge, Oak Ridge Reservation.** Staub, W.P.; Hopkins, R.A. (Oak Ridge National Lab., TN (USA)). May 1984. Contract AC05-84OR21400. 12p. NTIS, PC A02/MF A01; GPO Dep. Order Number DE84012021.

The thickness of residual soil overlying the Knox Group along Central Chestnut Ridge was estimated by a conventional seismic refraction survey. The purpose of this survey was to identify sites on the Department of Energy's Oak Ridge Reservation where ample overburden exists above the water table for the shallow land burial of low-level radioactive waste. The results of the survey suggest that the upper slopes of the higher ridges in the area have a minimum of 16 to 26 m (52 to 85 ft) of overburden and that the crests of these ridges may have more than 30 m (100 ft). Therefore, it is unlikely that sound bedrock would be encountered during trench excavation [maximum of 10 m (32 ft)] along Central Chestnut Ridge. Also, the relatively low seismic wave velocities measured in the overburden suggest that the water table is generally deep. On the basis of these preliminary results, Central Chestnut Ridge appears to be suitable for further site characterization for the shallow land burial of low-level radioactive waste. 3 references, 5 figures, 1 table.

27948 **(PB—84-163583) Management and disposal of alpha-contaminated wastes: a survey of current practices, strategies and R and D activities in some EC countries and the USA.** Mannone, F. (Commission of the European Communities, Ispra (Italy). Joint Research Centre). 1983. 145p. (EUR—8574-EN). NTIS, PC AE07/MF E07.

In view of the rationalization of the radwaste treatment, conditioning and storage procedures which so far have been applied at the Ispra Establishment, a survey of alpha-waste management practices and strategies currently in use or under development in some European Communities countries and in the USA has been carried out. In considering radwastes arising at nuclear research centers and nuclear plants, the greatest importance has been attached here to their alpha- rather than to their beta- or gamma-contamination level. Various process technologies currently practiced for pretreatment, conditioning, storage, and/or disposal of alpha-waste at several European nuclear centers and plants, as well as at some US DOE laboratories, have been scrutinized, including process operations aimed at recovering Pu, both for economic and ecological reasons. This report is intended to give the necessary background for a critical review of waste management practices so far applied at the Ispra Establishment, as well as for their possible modification according to more up-to-date management schemes.

27949 **(PNL—5005) Field performance assessment of synthetic liners for uranium tailings ponds: a status report.** Mitchell, D.H.; Spanner, G.E. (Pacific Northwest Lab., Richland, WA (USA)). Mar 1984. Contract AC06-76RL01830. 79p. NTIS, PC A05/MF A01; 1; GPO Dep. Order Number DE84012514.

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The objective of this study is to provide a database to support US Nuclear Regulatory Commission (NRC) licensing of uranium tailings leachate isolation impoundments. This objective is being accomplished by determining the effectiveness of design, installation, and quality assurance practices associated with uranium mill tailings impoundments with flexible membrane liners. The program includes testing of chemical resistance and physical performance of liners, leak detection systems, and seam inspection techniques. This report presents the status of the program through September 1983. The report addresses impoundment design, installation, and inspection techniques used by the uranium milling industry. To determine the relative successes of these techniques, information has been collected from consultants, mill operators, and the synthetic liner industry. Progress in experimental tasks on chemical resistance of liners, physical properties of liners, and nondestructive examination of seams is reported. 25 references, 9 figures, 13 tables.

27950 **(PNL-SA—11713) Evaluation of iron-base materials for waste package containers in a salt repository.** Westerman, R.E.; Nelson, J.L.; Kuhn, W.L.; Basham, S.G.; Moak, D.A.; Pitman, S.G. (Pacific Northwest Lab., Richland, WA (USA)). Nov 1983. Contract AC06-76RL01830. 17p. (CONF-8311124—3). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE84008948.

From 7. international symposium on the scientific basis for nuclear waste management; Boston, MA, USA (14 Nov 1983).

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Design studies for high-level nuclear waste packages for salt repositories have identified low-carbon steel as a candidate material for containers. Among the requirements are strength, corrosion resistance, and fabricability. The studies of the corrosion resistance and structural stability of iron-base materials (particularly low-carbon steel) are treated in this paper. The materials have been exposed in brines that are characteristic of the potential sites for salt repositories. The effects of temperature, radiation level, oxygen level and other parameters are under investigation. The initial development of corrosion models for these environments is presented with discussion of the key mechanisms under consideration. 6 references, 5 figures.

27951 **(PNL-SA—11714) Economic analysis of waste management alternatives for reprocessing wastes.** McKee, R.W.; Clark, L.L.; Daling, P.M.; Nesbitt, J.F.; Swanson, J.L.;. (Pacific Northwest Lab., Richland, WA (USA)). Feb 1984. Contract AC06-76RL01830. 12p. (CONF-840307—34). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE84011872.

From Waste management '84; Tucson, AZ, USA (11 Mar 1984).

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This study describes the results of a cost analysis of a broad range of alternatives for management of reprocessing wastes that would require geologic repository disposal. The intent was to identify cost-effective alternatives and the costs of potential repository performance requirements. Four integrated treatment facility alternatives for transuranic (TRU) wastes are described and compared. These include no treatment, compaction, incineration, and hulls melting. The advantages of reducing high-level wastes (HLW) volume are also evaluated as are waste transportation alternatives and several performance-related alternatives for emplacing waste in a basalt repository. Results show (1) that system costs for disposal of reprocessing waste are likely to be higher than those for disposal of spent fuel; (2) that volume reduction is cost-effective for both remote-handled (RH) TRU wastes and HLW, and that rail transport for HLW is more cost-effective than truck transport; (3) that coemplacement of RH-TRU wastes with HLW does not have a large cost advantage in a basalt repository; and (4) that, relative to performance requirements, the cost impact for elimination of combustibles is about 5%, long-lived containers for RH-TRU wastes can increase repository costs 10% to 20%, and immediate backfill compared to delayed backfill (bentonite/basalt) around the HLW canisters would increase repository costs up to 10% or overall system costs up to about 5%. 13 references, 4 figures, 12 tables.

27952 **(PNL-SA—11940) Organic geochemical studies at a commercial shallow-land disposal site of low-level nuclear waste.** Toste, A.P.; Kirby, L.J.; Pahl, T.R. (Pacific Northwest Lab., Richland, WA (USA)). Jan 1984. Contract AC06-76RL01830. 8p. (CONF-840307—33). NTIS, PC A02; 3; GPO Dep. Order Number DE84011361.

From Waste management '84; Tucson, AZ, USA (11 Mar 1984).

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The subsurface migration of radionuclides has been studied at a commercial, shallow-land burial site of low-level nuclear waste at Maxey Flats, Kentucky. A variety of radionuclides including ^{3}H, $^{238\ 239\ 240}Pu$, ^{60}Co, ^{137}Cs and ^{90}Sr have migrated short distances on-site (meters to tens of meters). A number of the mobile radionuclides, notably plutonium and ^{60}Co, appear to exist as anionic species with organic properties. As a result, we have studied the organic geochemistry of radioactive leachates pumped from a number of waste burial trenches throughout the site. The major aim of the organic research is to elucidate the role of organic compounds in mediating the subsurface migration of the mobile radionuclides in groundwater. A survey study of the hydrophilic and hydrophobic organic content of the waste leachates has revealed that organic compounds are readily leached from the buried waste. Organic chelating agents like EDTA, HEDTA and ED3A are the major hydrophilic organic compounds in the leachates, their concentrations ranging from 78 ppB to 19,511 ppB. A number of carboxylic acids are also present in the leachates, ranging from 675 ppB to 8757 ppB, collectively. A variety of hydrophobic organic compounds including barbiturates and other aromatic compounds, presumably waste-derived, are also present in the leachates, generally at lower ppB concentrations. A detailed chemical speciation study, aimed at determining whether any of the organic compounds identified in the survey study are associated with the mobile radionuclides, was undertaken using leachate from one of the waste trenches. It is clear that EDTA is chelated to plutonium and ^{60}Co in the leachate, potentially mobilizing these radionuclides. Other radionuclides, ^{137}Cs and ^{90}Sr, may be associated with polar organic compounds such as carboxylic acids. 14 references, 2 figures, 2 tables.

27953 **(PNL-SA—12086) Monitored Retrievable Storage Program: a mid-term report.** Hall, R.J.; Kreid, D.K. (Pacific Northwest Lab., Richland, WA (USA)). Feb 1984. Contract AC06-76RL01830. 12p. (CONF-840307—31). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE84010704.

From Waste management '84; Tucson, AZ, USA (11 Mar 1984).

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From an overall management perspective, the status of the Monitored Retrieval Storage (MRS) program can be summarized as follows: (1) the schedule is tight and is success oriented, however, it is achievable; (2) the program continues to be essentially on schedule; (3) two concepts have been selected for further design; (4) design for the 2 MRS concepts is underway and is expected to be at the thirty percent complete point in early summer, 1984; (5) peer review mechanisms have been established to insure valuable and timely input from industry, the academic community and other agencies; and (6) from a constructability standpoint, siting requirements are so general that a MRS facility could be constructed literally in any of the continguous United States. 4 references, 4 figures.

27954 **(SAND—83-2121C) Economic impacts of waste emplacement configuration for the proposed nuclear waste repository at the Nevada Test Site.** Scully, L.W.; Brasier, R.I.; Gram, H.F. (Sandia National Labs., Albuquerque, NM (USA); Los Alamos Technical Associates, Inc., NM (USA)). 11 Mar 1984. Contract AC04-76DP00789. 6p. (CONF-840307—28). NTIS, PC A02; 3; GPO Dep. Order Number DE84010598.

From Waste management '84; Tucson, AZ, USA (11 Mar 1984).

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The Nevada Nuclear Waste Storage Investigations Project is developing a conceptual design for a potential repository in welded tuff at Yucca Mountain, Nevada. Two different configurations are

under consideration for waste emplacement: vertical, with single waste canisters placed in holes in the floor of the emplacement drift; and horizontal, with multiple canisters placed in long holes in the walls of the drift. The cost of these two alternatives varies based on the amount of mining, borehole drilling, muck handling, and repository ventilation required. The difficulty of emplacement and retrieval operations also contributes to a cost differential. This paper presents these relative costs, showing a relative total cost differential of $880 million between the two methods. 9 references, 2 figures, 10 tables.

27955 **(SAND—83-2287C) Ambient temperature testing of the G-tunnel heated block.** Zimmerman, R.M.; Board, M.P.; Hardin, E.L.; Voegele, M.D. (Sandia National Labs., Albuquerque, NM (USA); Science Applications, Inc., La Jolla, CA (USA)). 1984. Contract AC04-76DP00789. 15p. (CONF-840633—13). NTIS, PC A02/MF A01; GPO Dep. Order Number DE84009927.

From 25. US symposium on rock mechanics; Evanston, IL, USA (25 Jun 1984).

The G-Tunnel heated block experiment is being conducted on the Nevada Test Site (NTS) as part of the Nevada Nuclear Waste Storage Investigations project (NNWSI). The purpose of the ambient temperature testing phase is to evaluate rock-mass mechanical properties of a block ($\sim 8\ m^3$) under biaxial stress changes up to 7.5 MPa above an initialization in situ value of 3.1 MPa. Results indicate that the modulus of deformation ranges from 9.7 to 17.0 GPa and Poisson's ratio ranges from 0.21 to 0.33. In general, the higher values of the modulus and Poisson's ratio were influenced by fracture propagations parallel to the compressive stress field. Other measurements indicated that cross-hole compression (p) wave velocities and single fracture permeability values were relatively insensitive to stress changes above the in situ value.

27956 **(SAND—83-2551/1) Low-level waste ocean disposal program. Annual technical progress report, June 1982-June 1983. Volume I. Summary.** Marietta, M.G. (Sandia National Labs., Albuquerque, NM (USA)). May 1984. Contract AC04-76DP00789. 121p. NTIS, PC A06/MF A01; 1; GPO Dep. Order Number DE84012569.

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This report describes the status of the oceanographic research program being conducted by Sandia National Laboratories (SNL) for the Bettis Atomic Power Laboratory (BAPL) in support of a US Navy environmental evaluation nuclear-powered submarines. The SNL project is entitled The Low-Level Waste Ocean Disposal Program (LLWODP). The present report covers the fourth year of the project and is presented in three volumes. Volume I provides a summary of the fourth year's accomplishments and updates the project status. Volume II and Volume III contain the scientific reports by the principal investigators for the activities during the fourth year in the Pacific and Atlantic study areas. 40 references, 52 figures, 11 tables.

27957 **(SAND—83-7436/1) NNWSI repository worker radiation exposure. Volume I. Spent fuel and high-level waste operations in a geologic repository in tuff.** Dennis, A.W.; Frostenson, J.C.; Hong, K.J. (Sandia National Labs., Albuquerque, NM (USA); Los Alamos Technical Associates, Inc., NM (USA)). May 1984. Contract AC04-76DP00789. 98p. NTIS, PC A05/MF A01; 1; GPO Dep. Order Number DE84012618.

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The Nevada Nuclear Waste Storage Investigations project has as one of its principal objectives the conceptual design of the buildings and facilities that will be required for a commercially generated radioactive waste repository. This report has been prepared for use by the repository designers in the conceptual design of the high-level (Volume I) and transuranic (Volume II) waste-handling facilities and equipment. This report contains a listing of repository operations tasks and the anticipated worker radiation exposure. All annual exposures are below the 5 rem permissible dose equivalent limit with seven worker positions exceeding the design objective of 1 rem. These worker exposures will be reduced by performing tasks remotely.

27958 **(UCID—20069) EQ3/6 geochemical modeling task plan for Nevada Nuclear Waste Storage Investigations (NNWSI).** Isherwood, D.; Wolery, T. (Lawrence Livermore National Lab., CA (USA)). 10 Apr 1984. Contract W-7405-ENG-48. 43p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE84012613.

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This task plan outlines work needed to upgrade the EQ3/6 geochemical code and expand the supporting data bases to allow the Nevada Nuclear Waste Storage Investigations (NNWSI) to model chemical processes important to the storage of nuclear waste in a tuff repository in the unsaturated zone. The plan covers the fiscal years 1984 to 1988. The scope of work includes the development of sub-models in the EQ3/6 code package for studying the effects of sorption, precipitation kinetics, redox disequilibrium, and radiolysis on radionuclide speciation and solubility. The work also includes a glass/water interactions model and a geochemical flow model which will allow us to study waste form leaching and reactions involving the waste package. A special emphasis is placed on verification of new capabilities as they are developed and code documentation to meet NRC requirements. Data base expansion includes the addition of elements and associated aqueous species and solid phases that are specific to nuclear waste (e.g., actinides and fission products) and the upgrading and documentation of the thermodynamic data for other species of interest.

27959 **(USGS-OFR—82-107) Regional hydrology of the Green River-Moab area, northwestern Paradox Basin, Utah.** Rush, F.E.; Whitfield, M.S.; Hart, I.M. (Geological Survey, Denver, CO (USA). Water Resources Div.). Dec 1982. Contract AI97-79ET44611. 113p. NTIS, PC A06/MF A01; 1; GPO Dep. Order Number DE84012126.

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The Green River-Moab area encompasses about 7800 square kilometers or about 25% of the Paradox basin. The entire Paradox basin is a part of the Colorado Plateaus that is underlain by a thick sequence of evaporite (salt) beds of Pennsylvanian age. The rock units that underlie the area have been grouped into hydrogeologic units based on their water-transmitting ability. Confining beds consist of evaporite beds of mostly salt, and overlying and underlying thick sequences of rocks with minimal permeability; above and below these confining beds are aquifers. The upper Mesozoic sandstone aquifer, probably is the most permeable hydrogeologic unit of the area and is the subject of this investigation. The principal component of groundwater outflow from this aquifer probably is subsurface flow to regional streams (the Green and Colorado Rivers) and is about 100 million cubic meters per year. All other components of outflow are relatively small. The average annual recharge to the aquifer is about 130 million cubic meters, of which about 20 million cubic meters is from local precipitation. For the lower aquifer, all recharge and discharge probably is by subsurface flow and was not estimated. The aquifers are generally isolated from the evaporite beds by the bounding confining beds; as a result, most ground water has little if any contact with the evaporites. Brines are present in the confining beds, but solution of beds of salt probably is very slow in most parts of the area. No brine discharges have been identified.

27960 **(USGS-OFR—84-23) Bibliography of reports by US Geological Survey personnel on studies of underground nuclear test sites and on waste management studies at the Nevada Test Site and the Waste Isolation Pilot Plant site, New Mexico, January 1 to December 31, 1982.** Glanzman, V.M. (Geological Survey, Denver, CO (USA)). 1984. Contract AI08-76DP00474;AI08-78ET44802. 19p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE84011514.

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This bibliography is divided into three categories: (1) reports regarding underground nuclear testing, (2) waste management projects at the Nevada Test Site and (3) waste management studies at the Waste Isolation Pilot Plant site. Reports are listed in each category by publication outlet. The USGS-474 series reports pertain to underground nuclear testing studies and are cross referenced to administrative (or in-house) series (for example, USGS-474-314 is cross referenced as NTS-50). The administrative series are used to

break down the USGS-474 series for more specific area identification.

27961 **(WINCO—1008) ICPP BIF filter room: decontamination and decommissioning plan.** Schmidt, D.A.; Moser, C.L. (Westinghouse Idaho Nuclear Co., Inc., Idaho Falls (USA)). May 1984. Contract AC07-84ID12435. 61p. NTIS, PC A04/MF A01; 1; GPO Dep. Order Number DE84012529.

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The BIF filter room within the ICPP Fuel Receiving and Storage Facility, CPP-603, has been identified as a high priority item on the INEL D and D Long Range Priority List. Decommissioning the BIF Filter Room will: (1) eliminate a potential radiation hazard; (2) eliminate a potential source of contamination; and (3) complete the required remedial action for a facility covered under the DOE Surplus Facilities Management Program's National Plan. This D and D plan provides the disassembly and removal of the entire contents of the BIF filter room, except as noted in Section 5.2.

27962 **Evaluation of crystalline rock as a medium for isolation of high-level waste.** Laughton, R.B.; Madia, W.J. (Battelle Columbus Laboratory, 505 King Avenue, Columbus, OH 43201). *Transactions of the American Nuclear Society;* **45**: 90-91(Oct 1983).

27963 **Evaluation of salt as a medium for isolation of high-level waste.** Goldsmith, S.; Heim, G.E.; Matthews, S.C. (Battelle Columbus Laboratories, 505 King Avenue, Columbus, OH 43201). *Transactions of the American Nuclear Society;* **45**: 88(Oct 1983).

27964 **Characterization of borosilicate glass containing Savannah River Plant radioactive waste.** Bibler, N.E.; Smith, P.K. (E.I. du Pont de Nemours & Co. Savannah River Lab. Aiken, SC 29808). pp 591-601 of Advances in materials characterization. Rossington, D.R.; Condrate, R.A.; Snyder, R.L. New York, NY; Plenum Publishing Corp. (1983). (CONF-820891—). Contract AC09-76SR00001.

From 18. ceramic science conference on advances in materials characterization; Alfred, NY, USA (16 Aug 1982).

This chapter characterizes radioactive glass made in a small, joule-heated melter in a shielded facility. Discusses glass preparation; glass and waste composition; glass microstructure and crystallinity; and glass durability. Uses optical and electron microscopy to show the presence of 1-5 wt % spinel crystals (primarily $NiFe_2O_4$). Leach tests indicate good durability in deionized water, brine, and silicate water. Release rates at 40C based on gamma, beta, and alpha activity in a 28-day test were approximately 0.01 g glass/m^2-day. Finds that during the leach tests, the pH of the leachates did not decrease even though they were exposed to the intense gamma, beta, and alpha radiation from this glass.

27965 **Microstructural characterization of nuclear waste ceramics.** Ryerson, F.J.; Clarke, D.R. (Lawrence Livermore National Lab. Univ. of California Livermore, CA 94550). pp 367-385 of Advances in materials characterization. Rossington, D.R.; Condrate, R.A.; Snyder, R.L. New York, NY; Plenum Publishing Corp. (1983). (CONF-820891—). Contract W-7405-ENG-48.

From 18. ceramic science conference on advances in materials characterization; Alfred, NY, USA (16 Aug 1982).

This chapter demonstrates how x-ray diffraction (XRD), scanning electron microscopy (SEM), electron probe microanalysis (EMPA), transmission electron microscopy (TEM) and analytical electron microscopy (AEM) can be applied to ceramic formulations designed to immobilize both commercial and defense-related reactor wastes. Uses these materials to address the strengths and limitations of the employed techniques. Discusses titanate-based nuclear waste ceramics; sample preparation; defense titanate ceramic; and commercial titanate ceramics (CTC). Suggests an iterative approach combining all these techniques.

27966 **Geomechanics in hard rock mining-Lessons from two case histories.** Heuze, F.E. (Lawrence Livermore National Laboratory, Livermore, CA). *Preprint, Society of Mining Engineers of AIME;* **82-364**: 14(Sep 1982).

This paper summarizes the geomechanics programs conducted in two hard rock underground mining operations in the Western United States, between 1966 and 1981. The two projects were directed towards understanding the behavior of the rock masses, at the scale of the caverns. To this end, the emphasis was put on large scale field measurements, complemented by limited laboratory testing. The results of these observations were used to build realistic finite element models of the underground chambers. In the marble mine, at Crestmore, California, the models were applied to the structural optimization of the room-and-pillar pattern. In the granite mining, at Climax, Nevada Test Site, the models explained some unusual stress changes observed during excavation. Based on the large number of geomechanical techniques employed, specific conclusions and recommendations are offered regarding the quality, applicability, and usefulness of the various methods. The two case histories clearly indicate that numerical models are extremely useful for a detailed understanding of the structural behavior of mine openings. To be realistic, these models must be based first and foremost on large scale field observations. The lessons learned on these two projects also are directly applicable to the design and analysis of nuclear waste repositories in hard rocks such as basalt, granite, and welded tuff.

27967 **(ORNL-tr—5110) Determination of the thermal properties of clays in large-size samples.** Bocola, W.; Girolimetti, G.; Giulianelli, G.; Tassoni, E.; Testa, L. (Oak Ridge National Lab., TN (USA)). Jun 1981. Contract AC05-84OR21400. C;CNEN-RT/ING(81)12. 49p. NTIS, PC A03/MF A01; GPO Dep. Order Number DE84010655.

The procedure adopted for the determination of the thermal properties of clays consists, very simply, of a series of heating tests conducted in a block of clay. These tests were followed by a parameter study, commonly called curve fitting, by means of which the field of experimental temperatures was continually compared with that of the theoretical calculated temperatures with the aid of a mathematical model that had already been successfully tested. The principal conclusions of the study that has been carried out can be summarized as follows: The apparent thermal conductivity measured using the method of curve fitting definitely falls between 0.014 and 0.016 W/cm°C. On the basis of the same method, the apparent diffusivity is the same at about 20 cm^2/h. Higher values cannot be considered because they do not agree with the values derived from the experimental curves. Lower values, which when coupled with less elevated values of thermal conductivity generate theoretical curves sufficiently faithful to the experimental curves, do not end up being realistic because they are much lower than the data commonly reported in the literature. Determination of the thermal properties using the method adopted can be considered valid only in first approximation, since it is known that they vary with temperature, whereas in the present study they were considered constant, even though a temperature increase of about 90°C was verified in the clay. On the whole the effect of heating on the thermal properties of the clay did not prove to be very relevant, at least in the temperature interval investigated, from the moment at which the clay of the block, which is cooled down after each test, reattains the initial equilibrium conditions, as resulted in tests 7 and 9. Analysis of the experimental data shows, as was logical to expect, the existence of preferential directions of thermal conduction, probably lying in the sedimentation plane of the clay.

0530 Environmental Aspects

REFER ALSO TO CITATION(S) 27952, 29502

27968 **(BNFO—81-2) Summary of parameters affecting the release and transport of radioactive material from an unplanned incident.** Walker, E. (Bechtel National, Inc., San Francisco, CA (USA). Nuclear Fuel Operations). Aug 1981. 95p. Nuclear Fuel Operations, Bechtel National Inc., San Francisco, CA. Order Number DE84900881.

This report has been prepared to serve as a reference source for assumptions and parameters utilized to evaluate the magnitude of airborne releases of radioactive materials from unplanned incidents in nuclear fuel cycle facilities. The report includes a summary of both measurements of these parameters and the corresponding assumed parameters used throughout the nuclear industry in preparing safety analysis reports. The scope of this study covers only the tabulation of the data described in the published reports surveyed. This study does not attempt to completely analyze any of the data in terms of cross correlations between factors, nor does it attempt to reduce data that is recorded in different forms to arrive at a common basis for comparison between the various data sources. 119 references, 21 tables.

27969 **(INIS-mf—8924) Environmental conditions of two abandoned uranium mill tailings sites in northern Saskatchewan.** Kalin, M. (Toronto Univ., Ontario (Canada). Inst. for Environmental Studies). (Saskatchewan Dept. of the Environment, Regina (Canada)). 1984. 103p. NTIS (US Sales Only), PC A06/MF A01. Order Number DE84780191.

Two abandoned uranium mill tailings sites near Uranium City, Saskatchewan, have been studied in an attempt to follow the natural rehabilitation processes. The Gunnar site is a largely terrestrial environment while the Lorado mill tailings were discharged mainly into Nero Lake. This report describes the ecological conditions of both sites, potential long-term environmental degradation, and possible measures to assist the recovery of both areas.

27970 **(INIS-mf—8932) Annual report on radioactive discharges and monitoring of the environment 1982.** (British Nuclear Fuels Ltd., Risley). Aug 1983. 83p. NTIS (US Sales Only), PC A05/MF A01. Order Number DE84780192.

A report is given on the liquid, airborne and solid radioactive discharges through authorised outlets and on environmental monitoring for all of BNFL's Works and sites for 1982, i.e. Sellafield Site and the Drigg Storage and Disposal Site; Chapelcross Works; Springfields Works and the Ulnes Walton Disposal Site; and Capenhurst Works. The report includes assessment of radiation doses to representative members of the most highly exposed group of the general population for the most important environmental pathways. At no time during 1982 have discharges and disposals of radioactive wastes through authorised outlets at any of the above Works exceeded those laid down in any of the Authorisations. (U.K.).

27971 **(NUREG—1071) Environmental impact appraisal for renewal of source material license No. SUB-526 (Docket No. 40-3392).** (Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Material Safety and Safeguards). May 1984. 101p. NTIS, PC A06/MF A01 - GPO $5.00. Order Number DE84901185.

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Allied Chemical Company operates a privately owned UF_6 production facility at Metropolis, Illinois, At this facility, uranium ore concentrates are converted into uranium hexafluoride (UF_6). The UF_6 product from this facility is shipped to Department of Energy (DOE) gaseous diffusion plants for enrichment of the ^{235}U isotope. This assessment: (1) reviews the operation of the facility during the recent license period by comparing the plant effluent releases or environmental monitoring data with permissible levels of contaminants; and (2) determines the impact on the environment from continued operation of the facility in its current configuration. 10 figures, 44 tables.

27972 **(PB—84-161934) Report on the invertebrate megafauna sampled by trawling in the Atlantic 3800 meter low-level radioactive waste disposal site. Final report.** Carney, R.S. (San Jose State Univ., Moss Landing, CA (USA). Moss Landing Marine Labs.). Aug 1983. 23p. NTIS, PC A02/MF A01.

Four otter trawls were carried out in 1978 near the Atlantic deepsea low-level radioactive waste dumpsite located at a depth of 3800 meters, approximately 320 kilometers offshore, centered at 37 degrees 50'N, 70 degrees 35'W, and situated in the axis of the Hudson Canyon Channel. The megafauna collected in the vicinity of the dumpsite can be described as an ophiuroid-pagurid (brittle starfish-hermit crab) dominated, soft-bottom abyssal assemblage. The life histories of the predominant large invertebrates are presented and discussed. The report makes particular note of the need to differentiate between natural spatial variation of organisms and spatial variations resulting from man's activities, when designing dumpsite-related biological monitoring programs.

27973 **(PB—84-164052) Prediction parameters of radionuclide retention at low-level radioactive waste sites.** Neiheisel, J. (Office of Radiation Programs, Washington, DC (USA)). Nov 1983. 39p. (EPA—520/1-83-025). NTIS, PC A03/MF A01.

Three low-level radioactive waste (LLW) sites situated within three of the major surficial deposits of the United States are being investigated to determine predictive parameters that may exist for assessing the radionuclide retention at future LLW sites. Each of the major surficial deposits has a unique assemblage of sorptive minerals, texture, and chemical environmental factors that affect the sorption mechanism of the radionuclides. The LLW sites are located at Beatty, Nevada; West Valley, New York; and Barnwell, South Carolina. Preliminary results reveal predictive linear relationships for cesium and strontium in a plot of the percent sorptive minerals versus the sorption coefficient (Kd). The percent sorptive minerals are determined by a quantitative mineral method.

27974 **(PNL-SA—11783) Use of natural radionuclides to predict the behavior of radwaste radionuclides in far-field aquifiers.** Hubbard, N.; Laul, J.C.; Perkins, R.W. (Pacific Northwest Lab., Richland, WA (USA)). Oct 1983. Contract AC06-76RL01830. 8p. (CONF-8311124—2). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE84011900.

From 7. international symposium on the scientific basis for nuclear waste management; Boston, MA, USA (14 Nov 1983).

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In appropriate aquifers the natural radionuclides of the U and Th decay series are important sources of information about the behavior of radwaste radionuclides in far-field aquifers. The Wolfcamp Carbonate, Pennsylvanian Carbonate and Granite Wash aquifers in the Palo Duro Basin of the Texas Panhandle are prime examples of such aquifers. Sampling and analysis for key radionuclides in the ground wasers of these aquifers are quite feasible and have been accomplished. Key early results are: (1) Ra does not appear to be retarded by sorption, (2) Th appears to be strongly sorbed, (3) kinetics seem to be different on time scales of days to months than on ones of hundreds of thousands of years, and (4) U and Th behave similarily when the time scales (half-lives) are similar, leading to the suggestion that uranium is in the +4 valence state in these aquifers. 10 references, 9 figures.

27975 **(PNL-SA—11796) Chemical migration by contact metamorphism between pegmatite/country rocks: natural analogs for radionuclides migration.** Laul, J.C.; Walker, R.J.; Shearer, C.K.; Papike, J.J.; Simon, S.B. (Pacific Northwest Lab., Richland, WA (USA); State Univ. of New York, Stony Brook (USA). Dept. of Earth and Space Sciences; South Dakota School of Mines and Technology, Rapid City (USA). Inst. of Mineral Deposits). Oct 1983. Contract AC06-76RL01830. 9p. (CONF-831174—86). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE84010899.

From Materials Research Society annual meeting; Boston, MA, USA (14 Nov 1983).

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Comparison of trace element signatures of country rocks as a function of distance from the contact with two pegmatites, Tin Mountain and Etta, in the Black Hills of South Dakota, suggests that some elements such as K, Li, Rb, Cs, As, Sb, Zn and Pb, have migrated to distances of 4 to 40 meters during contact metamorphism. The relative degree of migration varies depending on the element. On the other hand, there is virtually no migration of rare earth elements (REE), Al, Sc, Cr, Hf, U, and Th. Biotite and muscovite are effective trace element traps for Li, Rb and Cs. Biotite has a greater affinity for Rb, Cs and Li than muscovite.

27976 **(RHO-BW-ST—42-P) Delphi analysis of radionuclide release scenarios for a nuclear waste repository at the Hanford site, Washington state: initial iteration.** Davis, J.D.; Runchal, A.K.; Baumann, N.A.; Ervin, O.L. (Rockwell International Corp., Richland, WA (USA). Rockwell Hanford Operations). Sep 1983. Contract AC06-77RL01030. 207p. NTIS, PC A10/MF A01; 1; GPO Dep. Order Number DE84011860.

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The Columbia River basalts underlying the Hanford Site in Washington State are being characterized as a possible site for a nuclear waste repository. Identification, categorization, selection, and characterization of potential disruptions are important considerations for assessing long-term repository performance. Events, conditions, and processes potentially disruptive to repository isolation performance are analyzed by evaluating (1) uncertainties and omissions in characterizing the site; (2) credible events and processes resulting from the dynamics of natural systems; (3) changes in conditions affecting radionuclide isolation that are induced by the presence of the repository, and (4) credible changes to isolation capability resulting from human activities, other than repository construction or operation. Part I of this report presents the Basalt Waste Isolation Project methodology and rationale for identification, categorization, and initial analysis of potential Hanford Site candidate repository disruptions. Part II describes the implementation of the methodology and presents the results achieved. Part III consists of appendices to Parts I and II. This report will be a basis for future assessments of radionuclide release consequence scenarios. Several potential disruptions, will be selected for detailed characterization based on their assessments as bounding maximum potential radionuclide release risks for their respective occurrence probability categories. 83 references, 16 figures, 23 tables.

27977 **(SAND—83-0956) Continued fraction interpolation.** Brannen, J.P. (Sandia National Labs., Albuquerque, NM (USA)). Apr 1984. Contract AC04-76DP00789. 33p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE84011777.

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Interpolation by rational functions is especially useful for applications in which there are extended function ranges for abbreviated domains of definition. A particular case in point is the set of soil characteristic curves relating hydraulic conductivity, moisture content, and pressure head. In calculating the flow of fluids in unsaturated media, it is convenient to have values for both these curves and their derivatives. A relatively simple and accurate way to obtain both the curves and their derivatives from sparse data is via continued fraction interpolation. By defining the nth approximant F'/sub n/ of a continued fraction interpolant F/sub n/(x) = b_1 + H/sub n-1/(x), where H_1 - 1/b/sub n/; H/sub i/ = (x - x/sub n-1/)/(b/sub n-i+ H/sub i-1/); i = 2, ..., n-1; a very simple recursive for F'/sub n/(x) is derived as F/sub n/(x) = H'/sub n-1/.

27978 **Polonium-210 in the environment around a radioactive waste disposal area and phosphate ore processing plant.** Arthur, W.J. III; Markham, O.D. (Idaho National Engineering Lab., Idaho Falls). *Health Physics;* **46**: No. 4, 793-799(Apr 1984).

Polonium-210 concentrations were determined for soil, vegetation and small mammal tissues collected at a solid radioactive waste disposal area, near a phosphate ore processing plant and at two rural areas in southeastern Idaho. Polonium concentrations in media sampled near the radioactive waste disposal facility were equal to or less than values from rural area samples, indicating that disposal of solid radioactive waste at the Idaho National Engineering Laboratory Site has not resulted in increased environmental levels of polonium. Concentrations of ^{210}Po in soils, deer mice hide and carcass samples collected near the phosphate processing plant were statistically greater than the other sampling locations; however, the mean ^{210}Po concentration in soils and small mammal tissues from sampling areas near the phosphate plant were only four and three times greater, respectively, than control values. No statistical difference was observed for ^{210}Po concentrations in vegetation among any of the sampling locations.

0540 Health And Safety

REFER ALSO TO CITATION(S) 27957, 27976, 29203, 29242, 29311, 29438, 29439

27979 **(GA-A—16955) Safety evaluation of tunnel rack and dry well monitored retrievable storage concepts.** Ligon, D.M.; Seth, S.S.; Taniguchi, T.; Bolig, C.A. (GA Technologies, Inc., San Diego, CA (USA)). Dec 1983. Contract AT03-81SF11528. 158p. NTIS, PC A08/MF A01; 1; GPO Dep. Order Number DE84012857.

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This report discusses the safety evaluation of the dry well and tunnel rack concepts for the monitored retrievalbe storage of spent fuel assemblies from nuclear reactors and high-level waste from reprocessing plants. A list of initiating events that could have an impact on the safety of the facility was developed and screened for high-risk events. For both concepts, event trees and supporting fault trees were developed for the high-risk events; however, quantification of risk was performed only for the dry well concept. The results showed that transporter collision and canister drop accidents have the highest anticipated frequency of occurrence. These events are common to both concepts. The associated radiological release, however, is small. For the dry well concept, the seismic event leads to the most severe accident, but its frequency of occurrence is very small compared with the other initiating events evaluated. The expected risk to the US population from the operation of a dry well facility was found to be 1.2 x 10^{-2} latent cancer deaths per year in a population of 2 million around the reference site. 21 references, 19 figures, 14 tables.

27980 **(NUREG/CR—2955) Analysis of uranium urinalysis and in vivo measurement results from eleven participating uranium mills.** Spitz, H.B.; Simpson, J.C.; Aldridge, T.L. (Pacific Northwest Lab., Richland, WA (USA)). May 1984. Contract AC06-76RL01830. 64p. (PNL—4550). NTIS, PC A04/MF A01; 1 - GPO $4.50; GPO Dep. Order Number DE84012057.

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Uranium urinalysis and in vivo examination results obtained from workers at eleven uranium mills between 1978 and 1980 were evaluated. The main purpose was to determine the degree of the mills' compliance with bioassay monitoring recommendations given in the draft NRC Regulatory Guide 8.22 (USNRC 1978). The effect of anticipated changes in the draft regulatory guidance, as expressed to PNL in May 1982, was also studied. Statistical analyses of the data showed that the bioassay results did not reliably meet the limited performance criteria given in the draft regulatory guide. Furthermore, quality control measurements of uranium in urine indicated that detection limits at $\alpha = \beta = 0.05$ ranged from 13 μg/l to 29 μg/l, whereas the draft regulatory guidance suggests 5 μg/l as the detection limit. Recommendations for monitoring frequencies given in the draft guide were not followed consistently from mill to mill. The results of these statistical analyses indicate a need to include performance criteria for accuracy, precision, and confidence in revisions of the draft Regulatory Guide 8.22. Revised guidance should also emphasize the need for each mill to continually test the laboratory performing urinalyses by submitting quality control samples (i.e., blank and spiked urine samples as open and blind test) to insure that the performance criteria are being met. Recommendations for a bioassay audit program are also given. 25 references, 15 figures, 17 tables.

27981 **(NUREG/CR—3682) Nuclear fuel cycle risk assessment: review and evaluation of existing records.** Pelto, P.J.; Rhoads, R.E.; Vesely, W.E.; Fullwood, R.R. (Pacific Northwest Lab., Richland, WA (USA)). May 1984. Contract AC06-76RL01830. 164p. (PNL—4990). NTIS, PC A08/MF A01 - GPO 5.00; GPO Dep. Order Number DE84012153.

The US Nuclear Regulatory Commission initiated the Fuel Cycle Risk Assessment Program to provide risk assessment methods for use in the regulatory process for nuclear fuel cycle facilities other than reactors. The first report from this program, NUREG/CR-2873, defined and described fuel cycle elements considered in

the program. The second report, NUREG/CR-2933, described the survey and compilation of fuel cycle risk-related literature. This report presents a review of the state-of-the-art of risk assessment methods for nuclear fuel cycle facilities and an evaluation of the adequacy of these methods to meet NRC's needs for risk assessment information. The approach used to perform this work included: identification of potential uses of fuel cycle risk assessments at NRC; review of currently available fuel cycle risk assessment methods; and identification of potential methods development needs.

27982 **(NUREG/CR—3683) Nuclear fuel cycle risk assessment: program summary through Fiscal Year 1983.** Geffen, C.A.; Pelto, P.J.; Rhoads, R.E. (Pacific Northwest Lab., Richland, WA (USA)). May 1984. Contract AC06-76RL01830. 52p. (PNL—4991). NTIS, PC A04/MF A01; 1 - GPO $4.25; GPO Dep. Order Number DE84012163.

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The US Nuclear Regulatory Commission initiated the Fuel Cycle Risk Assessment Program to provide risk assessment methods for use in the regulatory process for nuclear fuel cycle facilities other than reactors. This report presents a summary of the work completed in the Fuel Cycle Risk Assessment Program through fiscal year 1983. These efforts include descriptions of representative non-reactor facilities (NUREG/CR-2873), a survey and computer compilation of risk-related literature (NUREG/CR-2933), a preliminary relative ranking of fuel cycle facilities on the basis of risk, and an assessment of the adequacy of existing risk assessment methods (NUREG/CR-3682). Further work in the program has been postponed at this point in time because of funding constraints and higher priorities for other ongoing programs within the NRC. This program summary document will serve as a reference for use in future fuel cycle risk assessment research.

27983 **(PNL-SA—11142) Radioactive emissions and radiation exposure from US Department of Energy operations.** Welty, C.G. Jr.; Hawley, K.A.; Dasti, A.Q.; Mathur, S.J.; Corley, J.P. (Pacific Northwest Lab., Richland, WA (USA); USDOE Assistant Secretary for Policy, Safety and Environment, Washington, DC. Office of Operational Safety). Jul 1983. Contract AC06-76RL01830. 21p. (CONF-830523—21). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE84010777.

From International conference on radioactive waste management; Seattle, WA, USA (16 May 1983).

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The United States Department of Energy (DOE) conducts through its operating contractors major nuclear research, development, and production operations at nearly 30 installations. Emission and environmental monitoring programs conducted at these sites are intended to assure effective effluent controls and compliance with applicable radiation standards. Radionuclide emissions from DOE facilities are reported annually to a central computer-based effluent information system. This system enables DOE management to identify emission sources and observe trends in emission levels. Emissions to the environment from all DOE installations in 1981 totaled 1.9 million curies, predominantly short-lived activity, noble gases, and tritium. Significant trends in emissions and population exposures resulting from the emissions are discussed. Each DOE installation prepares an annual environmental monitoring report summarizing radionuclide emissions and computed radiation dose to the public within an 80-km radius. Actual measurements of radioactivity in human exposure pathways are used whenever possible to calculate dose to the public. Often it is necessary to calculate doses using effluent and meteorological data and appropriate dispersion equations. Calculations include the maximum-individual dose and the 80-km population dose. Assessments of population dose at DOE installations in 1981 indicate that the offsite exposure of the maximum individual did not exceed 3% of the 500 mrem limit at any site, and generally was at most sites. For 1981, the calculated population whole-body dose within an 80-km radius of individual DOE sites ranged up to 120 man-rems and totaled about 230 man-rems.

27984 **(UCRL—53498) Radiation dosimetry and monitoring for a test of geologic storage of spent nuclear fuel.** Raschke, K.E.; Patrick, W.C.; Roy, T.C.; Straume, T. (Lawrence Livermore National Lab., CA (USA)). 30 Nov 1983. Contract W-7405-ENG-48. 16p. NTIS, PC A02/MF A01; GPO Dep. Order Number DE84011456.

The Lawrence Livermore National Laboratory, at the request of the U.S. Department of Energy, conducted a test at the Nevada Test Site to evaluate both the feasibility of deep data extrapolated to proposed Test and Evaluation Facility and Monitored Retrievable Storage schemes indicate that personnel exposures would be much lower than the yearly guides set by the National Commission on Radiological Protection. The dose commitment in person-rem resulting from spent-fuel storage is extrapolated to be about 0.2% of that currently accepted in the normal operation of nuclear power plants. This report describes the radiological monitoring and dosimetry program that was instituted to limit personnel exposure to ionizing radiation and to determine the extent of any gaseous or particulate release. During the three-year storage phase, no measurable radioactive effluent was released to the atmosphere, soil, or water. Radiation exposures to personnel handling the shielded fuel assemblies (> 50,000 rad/h at contact) were less than 0.4 person-rem for the duration of the project or less than 0.016 person-rem per spent-fuel handling operation.

0550 Regulations

27985 **(DOE/DP—0001/13) Strategic special nuclear material inventory differences. Semi-annual report, October 1, 1982-March 31, 1983.** (USDOE Assistant Secretary for Defense Programs, Washington, DC. Office of Safeguards and Security). Jan 1984. 25p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE84011792.

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This thirteenth periodic semiannual report of Inventory Differences (ID) covers the first six months of fiscal year 1983 (October 1, 1982-March 31, 1983), for the Department of Energy (DOE) and DOE contractor facilities possessing significant quantities of strategic special nuclear material (SSNM). Inventory Differences are simply the differences between the amount of material shown in the accounting records and the amount of material reported in the physical inventory. These differences are generally due to errors in estimating material in unmeasurable form at the time of an inventory, unmeasssurable holdup in equipment, measurement imprecisions, inaccuracies in initial determinations of SSNM produced or used in nuclear reactors, and inventory or bookkeeping errors. Both DOE and contractors operating DOE facilities carefully maintain, analyze, and investigate ID data.

27986 **(DOE/DP/30215—T1) Development of deterrence strategies.** Pilgrim, M.K.; Fineberg, M.L.; Ely, R.S.; Smith, M.A.; Mengel, R.W. (BDM Corp., McLean, VA (USA)). Sep 1981. Contract AC01-80DP30215. 156p. NTIS, PC A08/MF A01; GPO Dep. Order Number DE84012284.

Report BDM/W-81-470-TR.

The development of deterrence strategies requires an in-depth understanding of the characteristics and decision-making processes of all categories of potential adversaries to DOE facilities and programs. A second component needed is recognition of the strengths and vulnerabilities of the safeguards system surrounding the target since each contributes significantly to the adversaries' perception of risk and attractiveness associated with that target. An understanding of the local and national societal conditions which might create or exacerbate terrorism, criminal activity or other types of malevolent action is a third analytic element necessary to support develoment of deterrents. Knowledge of the dynamics of these three components provides the analytical basis upon which initial definition of the types and approaches to deterrence can be arrived at. The analyses and results described in this report address each of these components and provide a solid conceptual, qualitative and quantitative base from which to develop specific deterrence strategies. 16 figures, 8 tables.

27987 **(DOE/DP/30215—T2) Handbook for development of deterrence strategies.** Pilgrim, M.K.; Mengel, R.W. (BDM Corp., McLean, VA (USA)). Sep 1981. Contract AC01-80DP30215. 146p. NTIS, PC A07/MF A01; GPO Dep. Order Number DE84012283.

Report BDM/W-81-470-TR.

The handbook provides the DOE security manager with a guide to deterrence strategies that might be used to complement and enhance the existing safeguards and security program. It is not intended that these strategies be viewed as a replacement for current physical protection, nor as a means of reducing physical protection requirements. All strategies are not applicable to each facility, and certain strategies are better implemented from DOE Headquarters (Office of Safeguards and Security).

27988 **(DOE/EIA—0446) Investor perceptions of nuclear power.** Hewlett, J.G. (USDOE Energy Information Administration, Washington, DC. Office of Coal, Nuclear, Electric and Alternate Fuels). May 1984. 117p. NTIS, PC A06/MF A01; 1 - GPO; GPO Dep. Order Number DE84012579.

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Evidence is provided that investor concerns about nuclear power have recently been reflected in the common stock returns of all utilities with such facilities and have resulted in a risk premium. In particular, over the 1978-1982 period, three nuclear-related events occurred at the same time as, and therefore appear to have caused, significant drops in the market values of nuclear utilities relative to their non-nuclear counterparts. The three events were as follows: the accident at TMI, which occurred in March 1979; the realization in the summer of 1980 that an accident of the magnitude of TMI could result in cleanup costs of over $1 billion, which are not completely insurable and could therefore result in substantial losses; and the summer 1982 decision by the Tennessee Valley Authority (TVA) to cancel some if its nuclear power plant construction projects, and the Nuclear Regulatory Commission (NRC) decision to stop work on the construction of the Zimmer reactor, followed by a warning that it might close the Indian Point 2 and 3 reactors. If an individual had invested $100 in an average nuclear utility on the day before the TMI accident and reinvested all dividends, the value of this investment would have fallen by 10% relative to an identical investment in the average non-nuclear utility. The risk of investments in nuclear power versus conventional generating technologies shows nuclear power to be a relatively risky investment. However, relative to all investments, nuclear power was less risky in terms of the type of risk that would cause investors to require a premium before purchasing their securities. 6 figures, 6 tables.

27989 **(DOE/NBM—4012850) Nuclear materials control in research and test reactor operations.** (Phillips Petroleum Co., Idaho Falls, ID (USA). Atomic Energy Div.; General Electric Co., Richland, WA (USA). Hanford Atomic Products Operation). Jan 1961. 50p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE84012850.

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This manual presents the basic principles and techniques which have been found necessary for the establishment and maintenance of an adequate control system for the nuclear materials used in research and test reactor operations in the United States. In general, the application of these principles and techniques would be required wherever it was necessary for a central agency such as a state to be able to satisfy either itself or another agency or state regarding the safety, national security, and economy of its atomic installations. The fundamental basis of any system designed to assure efficient control of nuclear materials is the ability to measure accurately the receipt, issue, use, and inventory of all such materials.

27990 **(IEAL-R—84-1-Vol.1) Review and evaluation of the Nuclear Materials Management and Safeguards System (NMMSS). Volume 1. Comparison of DOE nuclear materials information system requirements with NMMSS capabilities and recommendations for NMMSS improvements.** (International Energy Associates Ltd., Washington, DC (USA)). Mar 1984. Contract AC01-83DP30222. 106p. NTIS, PC A06/MF A01; GPO Dep. Order Number DE84009465.

This report documents the result of a review of the Nuclear Materials Management and Safeguards System (NMMSS), a Department of Energy nuclear materials control and accountability data base and information processing system. This review was performed to determine what data are required from the NMMSS, how it is collected, and how it is used. Based upon the review, NMMSS deficiencies and excess capabilities were identified and a draft set of requirements for the nuclear materials information system that the Office of Safeguards and Security (OSS) should be supporting as well as recommendations for attaining that capability.

27991 **(IEAL-R—84-1-Vol.2) Review and evaluation of the Nuclear Materials Management and Safeguards System (NMMSS). Volume 2. Analysis of DOE nuclear materials information resource requirements.** (International Energy Associates Ltd., Washington, DC (USA)). Mar 1984. Contract AC01-83DP30222. 102p. NTIS, PC A06/MF A01; GPO Dep. Order Number DE84009466.

This section of the discussion of the system requirements for the Nuclear Materials Management and Safeguards System (NMMSS) presents a brief discussion of the historical development of both the NMMSS and its system requirements.

27992 **(IEAL-R—84-1-Vol.3) Review and evaluation of the Nuclear Materials Management and Safeguards System (NMMSS). Volume 3. Analysis of NMMSS capabilities.** (International Energy Associates Ltd., Washington, DC (USA)). Mar 1984. Contract AC01-83DP30222. 150p. NTIS, PC A07/MF A01; GPO Dep. Order Number DE84009478.

This section describes the Nuclear Materials Management and Safeguards System (NMMSS) and discusses, briefly, its theoretical capabilities. Despite the number of other documents that describe NMMSS, this section is included to describe the way that data are entered, stored, and processed by application programs within NMMSS to produce reports. Previous NMMSS descriptions have either been so general that they do not explain the operation of the system in sufficient detail to provide a solid understanding of its capabilities and limitations, or they have been so microscopic that the discussion of edit checks and authority file elements tended to obscure the major facets of system operation. This description is intended to fill this void by presenting a brief overview followed by a discussion of system operation and capabilities that is adequate for an overall understanding of NMMSS uncluttered by minutiae.

27993 **(INIS-mf—8938) Report on the current situation with regard to nuclear fuel and the operations of Svensk Kaernbraenslefoersoerjning AB. Report to the Swedish Ministry of Industry, November 1982.** (Svensk Kaernbraenslefoersoerjning AB, Stockholm). Nov 1982. 42 p.p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE84780257.

The cost of supplying nuclear fuel, including the reserve stockpile, has averaged about SEK 0.033/kWhe during the report period. The temporary storage facility for spent fuel, CLAB, is scheduled to be completed at Simpevarp at the beginning of 1985. Licensing applications have been submitted to the appropriate authorities for the construction of a final repository for reactor waste (SFR) in an underground facility to be built in the rock adjacent to the Forsmark nuclear power station. The first outbound shipment from Ringhals under the reprocessing contract between SKBF and COGEMA of France is planned to take place around the start of 1983. Reprocessing will commence in 1985 at the earliest. The uranium (approx. 850 tonnes) and plutonium (approx. 6 tonnes) obtained from reprocessing is Swedish property. Broad and long-range research is currently being conducted in order to further refine the technology and select a site for the final repository, SFL. Efforts are now being concentrated on the final storage of spent fuel without reprocessing. Construction of the repository is scheduled to start in 2010 and operation in 2020. SKBF submitted a report on 30 June of this year to the National Board for Spent Nuclear Fuel (NAK). The report included a cost estimate in 1981 prices for the management and various stages in the back end of the nuclear fuel cycle. The estimate, comes out to SEK 32 billion, which represents about 10% of the value of the electrical power produced by the nuclear power plants. The Government has decid-

ed upon a rate of SEK 0.017/kWhe of electricity generated by nuclear power as the 1982 charge to be paid to the state (NAK). The total cost picture for nuclear fuel (including provision for the costs of decommissioning of nuclear power plants) is then: fuel supply incl. reserve stockpile SEK 0.033/kWhe, back end incl. decommissioning SEK 0.018/kWhe. Total SEK 0.051/kWhe. (author).

27994 **(LA-UR—84-1390) System for imaging plutonium through heavy shielding.** Kuckertz, T.H.; Cannon, T.M.; Fenimore, E.E.; Moss, C.E.; Nixon, K.V. (Los Alamos National Lab., NM (USA)). Apr 1984. Contract W-7405-ENG-36. 6p. (CONF-840531—3). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE84011346.

From 6. annual symposium on safeguards and nuclear material management; Venice, Italy (14 May 1984).

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A single pinhole can be used to image strong self-luminescent gamma-ray sources such as plutonium on gamma scintillation (Anger) cameras. However, if the source is weak or heavily shielded, a poor signal to noise ratio can prevent acquisition of the image. An imaging system designed and built at Los Alamos National Laboratory uses a coded aperture to image heavily shielded sources. The paper summarizes the mathematical techniques, based on the Fast Delta Hadamard transform, used to decode raw images. Practical design considerations such as the phase of the uniformly redundant aperture and the encoded image sampling are discussed. The imaging system consists of a custom designed m-sequence coded aperture, a Picker International Corporation gamma scintillation camera, a LeCroy 3500 data acquisition system, and custom imaging software. The paper considers two sources - 1.5 mCi ^{57}Co unshielded at a distance of 27 m and 220 g of bulk plutonium (11.8% ^{240}Pu) with 0.3 cm lead, 2.5 cm steel, and 10 cm of dense plastic material at a distance of 77.5 cm. Results show that the location and geometry of a source hidden in a large sealed package can be determined without having to open the package. 6 references, 4 figures.

27995 **(LA-UR—84-1517) Optimal allocation of inspection resources.** Markin, J.T.; Chambers, W.H.; Vaccaro, H.S. (Los Alamos National Lab., NM (USA)). 1984. Contract W-7405-ENG-36. 5p. (CONF-840531—7). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE84012632.

From 6. annual symposium on safeguards and nuclear material management; Venice, Italy (14 May 1984).

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Allocation of inspection resources for international safeguards is considered as the problem of designing a complex system that is composed of individual inspection activities and that has the objective of detecting material loss. Optimization theory is applied in selecting those inspection activities that maximize a system performance measure within resource constraints. The method is applicable to a global allocation problem in which inspection resources are distributed throughout a hierarchy consisting of multiple countries, multiple facilities within each country, and multiple activities within each facility. 9 references.

27996 **(NUREG—1065) Acceptance criteria for the low enriched uranium reform amendments.** Emeigh, C.W.; Gundersen, G.E.; Withee, C.J. (Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Material Safety and Safeguards). May 1984. Contract AC06-76RL01830. 50p. NTIS, PC A03/MF A01; 1 - GPO $4.50; GPO Dep. Order Number DE84012562.

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Revisions have been made to the material control and accounting requirements for NRC licensees authorized to possess and use more than one effective kilogram of special nuclear material of low strategic significance to have material control and accounting systems able to (1) confirm the presence of special nuclear material, (2) resolve indications of missing material, and (3) aid in the investigation and recovery of missing material. This document presents criteria that can be used to aid in judging the acceptability of licensee plans that would be submitted to the NRC for implementing these capabilities. General performance objectives, system capabilities, and recordkeeping are addressed.

27997 **(PNL-SA—11835) Automated program for the acquisition of tank calibration data.** Liebetrau, A.M. (Pacific Northwest Lab., Richland, WA (USA)). Nov 1983. Contract AC06-76RL01830. 11p. (CONF-831106—26). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE84011882.

From Topical meeting on safeguards technology - the process safeguards interface; Hilton Head Island, SC, USA (28 Nov 1983).

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A computer program has been developed to acquire calibration data for nuclear process vessels. The program automates the process so that the need for operator intervention during a calibration run is minimized. The program depends upon the calibration system it is designed to operate, but its modular structure makes it easy to adapt to other systems. An important feature of the program is the sequence of steps taken to acquire calibration data and to ensure their validity. Readings are taken in groups, and data are rejected if any reading differs by more than a specified value from the mean of its group. Cumulative-sum control charts are maintained for seven parameters, each of which measures some aspect of increment-to-increment consistency during the calibration run. If one of te consistency checks drifts out of control, the program pauses so that appropriate corrective action can be taken. The calibration run proceeds without manual intervention when all consistency checks are in control.

27998 **(SAND—83-1385) EASI graphics - Version II.** Allensworth, J.A. (Sandia National Labs., Albuquerque, NM (USA)). Apr 1984. Contract AC04-76DP00789. 56p. NTIS, PC A04/MF A01; 1; GPO Dep. Order Number DE84012414.

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EASI (Estimate of Adversary Sequence Interruption) is an analytical technique for measuring the effectiveness of physical protection systems. EASI Graphics is a computer graphics extension of EASI which provides a capability for performing sensitivity and trade-off analyses of the parameters of a physical protection system. This document reports on the implementation of the Version II of EASI Graphics and illustrates its application with some examples. 5 references, 15 figures, 6 tables.

27999 **(SAND—84-1049C) Test of an LWR fuel assembly sealing system in a demonstration experiment at the Kahl Experimental Nuclear Power Station.** Brueckner, C.; Heger, H.; Pachl, L.; Dennys, R.; McKenzie, J.M.; Suber, L.A.; Patterson, J.F. (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.); Vereinigung Deutscher Elektrizitaetswerke e.V. (VDEW), Frankfurt am Main (Germany, F.R.); Versuchsatomkraftwerk G.m.b.H., Kahl/Main (Germany, F.R.); International Atomic Energy Agency, Vienna (Austria); Sandia National Labs., Albuquerque, NM (USA); Exxon Nuclear Co., Inc., Richland, WA (USA)). 1984. Contract AC04-76DP00789. 4p. (CONF-840531—2). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE84011486.

From 6. annual symposium on safeguards and nuclear material management; Venice, Italy (14 May 1984).

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Twelve Exxon Nuclear fuel assemblies presently in the Kahl Boiling Water Reactor core are sealed with FAID ultrasonic seals. The sealing system in this demonstration experiment is designed to meet safeguards, reactor safety, and fuel handling requirements. Results of these ongoing experiments are presented. 3 references, 1 figure.

28000 **Neutron techniques in safeguards.** Zucker, M.S. (Brookhaven National Lab., Upton, NY (USA)). *Institute of Physics, Conference Series;* 463-468(1983). (CONF-820950—).

From Conference on the neutron and its applications; Cambridge, UK (13 Sep 1982).

The techniques employed rely on a wide selection of the many methods of neutron generation, detection, and data analysis that have been developed for neutron physics and nuclear science in general.

07 ISOTOPE AND RADIATION SOURCE TECHNOLOGY

0702 Radiation Sources

28001 **(CONF-8404143—2) High-current, low-energy synchrotrons and compressor rings.** Kustom, R.L. (Argonne National Lab., IL (USA)). 1 May 1984. Contract W-31-109-ENG-38. 9p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE84012104.

From 10. international conference on cyclotrons and their applications; East Lansing, MI, USA (30 Apr 1984).

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The primary application of high-current, low-energy synchrotrons and linac compressor rings is as proton drivers for pulsed-spallation neutron sources. They operate in the range of 500 to 1500 MeV with extracted beam repetition rates between 12 to 100 Hz. The time-averaged currents on target are a few tens of microamperes today, soon will be a few thousand in the future. The characteristics for the accelerators and compressor rings, their limitations, and existing and proposed major facilities are described. 22 references, 5 figures, 6 tables.

28002 **(SAND—83-0838) PIXE and PBFA II: pulsed x-ray source feasibility study.** Sanford, T.W.L.; Beezhold, W. (Sandia National Labs., Albuquerque, NM (USA)). Apr 1984. Contract AC04-76DP00789. 84p. NTIS, PC A05/MF A01; 1; GPO Dep. Order Number DE84011535.

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The feasibility of PIXE (Proton Induced X-Ray Emission) radiation as an intense source of K, L, and M-shell x-rays is explored using PBFA-II as 2-40 MeV, multi-MA proton source. Because the peak of the characteristic x-ray production cross sections lie in the multi-MeV range for protons, PBFA-II, when optimized for maximum proton current, should be an ideal source. However, the efficiency for converting the proton energy to characteristic x-ray energy in the target is only of the order of 0.1 and is strongly dependent on target material. Furthermore, the emission of these low-energy x-rays from the target is dominated by absorption in the target. Two simple target designs have been considered that enables about 20 of the x-rays generated in the target to reach an area outside the target that is to be irradiated. One design which employs high magnetic-fields suffers from complications arising from the fields; the other design employs a tilted target and suffers from proton contamination at the area to be irradiated. Owing to the high efficiency possible with the tilted target, it is discussed in detail. Depending on the proton energy and the target material, surface doses up to a few hundred cal/gm over 500 cm^2 are possible using PBFA-II. Because of the low energy of the x-rays, however, the fluence is only of the order of 0.2 cal/cm^2 for all the targets considered. Additionally, because of the high energy density of the beam on target, a shield that is sufficiently thick to stop the target debris will most probably be too thick to transmit the low-energy x-rays. Accordingly, it will be necessary to do without such a shield and to complete x-ray effects measurements before the slow velocity debris arrives. 18 references, 30 figures, 11 tables.

0703 Isotopic Power Supplies

REFER ALSO TO CITATION(S) 28328

28003 **(DOE/ET/20342—T12) APL/JHU free flight tests of the General Purpose Heat Source module. Testing: 5-7 March 1984.** Baker, W.M. II. (Air Force Flight Dynamics Lab., Wright-Patterson AFB, OH (USA)). 1984. Contract AI01-77ET20342. 42p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE84011065.

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Purpose of the test was to obtain statistical information on the dynamics of the General Purpose Heat Source (GPHS) module at terminal speeds. Models were designed to aerodynamically and dynamically represent the GPHS module. Normal and high speed photographic coverage documented the motion of the models. This report documents test parameters and techniques for the free-spin tests. It does not include data analysis.

28004 **(DPST—83-128-1) ^{238}Pu fuel form processes. Final report, January-September 1983.** Mosley, W.C.; Taylor, D.H. (Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA)). 1983. Contract AC09-76SR00001. 124p. NTIS, PC A06/MF A01; 1; GPO Dep. Order Number DE84011141.

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Progress is reported on the following: analytical studies of weld-quench cracking in DOP-26 iridium alloy, iridium/$^{238}PuO_2$ compatibility test, surface area measurements of $^{238}PuO_2$ using the Blaine air permeability apparatus, and helium release from $^{238}PuO_2$. (MHR)

28005 **(GEPP-TIS—815) Control system for glassing hot presses.** Howell, J.F. (General Electric Co., St. Petersburg, FL (USA). Neutron Devices Dept.). 13 Jun 1984. Contract AC04-76DP00656. 28p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE84012303.

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A software programmable control system has been developed that automates the glass fusing process used in the production of semiconductor thermopile elements. The new control system replaces an older, mostly manual, electromechanical design. This report describes the new control design and its functional features.

28006 **(MLM—1418) Mound Laboratory isotopic power fuels programs: April-June, 1967. AEC research and development report.** (Monsanto Research Corp., Miamisburg, OH (USA). Mound). 11 Aug 1967. Contract AC04-76DP00053. 45p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE84010297.

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Polonium-210 metal and compounds and plutonium-238 metal and dioxide are used as fuels for heat sources. Progress in the development of methods of preparing the fuels and the determination of the characteristics of the fuels is reported. The evaluation of capsule materials under various environmental conditions and with various forms of plutonium-238 and polonium-210 is presented. (MHR)

08 HYDROGEN

0801 Production

REFER ALSO TO CITATION(S) 27769, 28070, 28543, 28569

28007 **(BMFT-FB-T—84-032) High temperature electrolysis of water vapour, HOT ELLY phase II A.** Doenitz, W.; Erdle, E.; Hermeking, H.; Koch, A.; Kock, W.; Roettenbacher, R.; Schaefer, W.; Schamm, R.; Schmidberger, R. (Bundesministerium fuer Forschung und Technologie, Bonn (Germany, F.R.)). Feb 1984. 252p. (In German). NTIS (US Sales Only), PC A12/MF A01. Order Number DE84751504.

The goal of the project HOT-ELLY Phase II a was the systematic continuation of the basic developments for the high temperature electrolysis of water vapour, which had been elaborated in Phase I already, with respect to a technical realization of the process. The optimization of the electrolyte geometry and of the materials for the interconnection of cells as well as the manufacture and tests of electrolysis tubes consisting of serial connected cells were the central tasks. For single cells as well as for serial connected cells stable operation over a period of 1000 h could be demonstrated. Characteristic data for an electrolysis tube at 1000°C and an average cell voltage of 1.33 V were a current density of 0.37 A/cm^2 and a H_2O-conversion of 85%. For the integration of a large number of electrolysis tubes into so-called modules, which represent the smallest units of future electrolysis plants, a constructional concept has been developed and successfully tested with respect to all its essential elements. Together with the partner company Lurgi, which investigated problems of the process engineering for HOT-

ELLY in a parallel project, an autothermal process version has been designed which is only based on the availability of low temperature steam and electricity.

28008 **(BNL—34204) Rationale for US DOE energy storage program in hydrogen technology.** Beller, M.; Mezzina, A. (Brookhaven National Lab., Upton, NY (USA)). Jan 1984. Contract AC02-76CH00016. 12p. (CONF-840702—5). NTIS, PC A02/MF A01; GPO Dep. Order Number DE84010225.

From 5. world hydrogen energy conference; Toronto, Canada (15 Jul 1984).

The objective of this work is to develop a multi-year research and development plan based on a systematic evaluation of the mission of the Chemical/Hydrogen Energy Systems Program (C/HES) at Brookhaven National laboratory (BNL). The methodology of this study is to systematically examine the important facets of the energy system. These are supply, storage, transmission and distribution, and end use (consumption). Within these sectors, all options are examined and ranked according to a set of attributes which are of importance economically, environmentally, and institutionally. This multi-attribute ranking system is useful not only from the total score obtained, but in evaluating those individual attributes where R and D needs are pointed out. Finally, the results of the analysis are used to delineate areas and priorities for technology base R and D. This study provides a systems analysis of the present status and future potential of various hydrogen production, storage, transmission, and use options. It concludes that research and development priorities should focus upon these options in the order stated above. Additionally, within each category selected technologies are outlined for specific research effort based upon a multi-objective analysis. In particular, hydrogen production options should stress work in the areas of high temperature electrolysis and anode depolarization. In the storage area, a variety of novel options seem amenable for investigation at reduced levels of expenditure. Transmission/distribution system requirements are also outlined. 2 references, 2 figures, 4 tables.

28009 **(BNL—34233) Water vapor electrolysis: systems considerations and cost/performance benefits.** Salzano, F.J.; Skaperdas, G.; Mezzina, A. (Brookhaven National Lab., Upton, NY (USA)). Jan 1984. Contract AC02-76CH00016. 15p. (CONF-840702—4). NTIS, PC A02/MF A01; GPO Dep. Order Number DE84007389.

From 5. world hydrogen energy conference; Toronto, Canada (15 Jul 1984).

The energy intensiveness of conventional liquid water electrolysis has inhibited the universal acceptance of this established technology as a resource conversion, storage and transport option. New developments in recent years have focused on the goal of reducing electric energy requirements as well as overall system capital cost. Major gains are envisioned in meeting these goals if water vapor electrolysis were conducted at elevated temperatures. The fundamental thermodynamics of a high temperature electrolysis process operating at ~ 1000°C are presented. Further, process considerations are examined in terms of engineering requirements in efficiency can be of the order of 40 to 50% over energy efficiencies attained via conventional liquid water electrolysis. Process tradeoffs are discussed in terms of overall thermal efficiencies, voltage/thermal requirements, steam conversions and heat recovery. Tradeoff analyses suggest that high temperature electrolyzers will operate most cost effectively when balance-of-system complexity and cost are minimized, even at the expense of voltage efficiency. This incentive justifies continued research and development support targetted to the far term, although near-term opportunities are recognized. 14 references, 6 figures, 4 tables.

28010 **(BNL—34391) Activities at the Brookhaven National Laboratory integrated test bed for advanced hydrogen technology.** Metz, P.D.; Leigh, R.W. (Brookhaven National Lab., Upton, NY (USA)). Jan 1984. Contract AC02-76CH00016. 9p. (CONF-840702—6). NTIS, PC A02/MF A01; GPO Dep. Order Number DE84010226.

From 5. world hydrogen energy conference; Toronto, Canada (15 Jul 1984).

Brookhaven National Laboratory (BNL) is developing an Integrated Test Bed to illustrate renewable energy-based hydrogen energy systems. A coordinated program of system testing, computer simulation, and economic analysis has been developed to characterize and optimize these systems. The first phase of this effort investigates the use of solar energy to produce hydrogen from water via photovoltaic-powered electrolysis. After briefly describing the activities planned for the facility and the photovoltaic-electrolyzer system now in place, this paper presents a synopsis of the results of recent transient simulations of PV-electrolyzer systems. The transient simulation program TRNSYS was used, with existing, modified, or new component subroutines as required. Innovative features of the modeling include the use of real weather data, and detailed simulation of system control strategies over a wide range of array power and voltage ratings. For directly coupled systems, we found the PV array power and voltage ratings. For directly coupled systems, we found the PV array voltage which maximizes hydrogen production to be quite near the nominal electrolyzer voltage for a wide range of PV array powers. The use of an ideal (100% efficient) maximum power tracking system provides only a six percent increase in annual hydrogen production. 11 references, 6 figures.

28011 **(BNL—34594) Photoelectrochemistry of conducting polymers.** Inganaes, O.; Skotheim, T.A.; Lundstroem, I. (Brookhaven National Lab., Upton, NY (USA); Linkoeping Univ. (Sweden). Lab. for Applied Physics). 1983. Contract AC02-76CH00016. 32p. NTIS, PC A03/MF A01; GPO Dep. Order Number DE84010889.

The authors conclude that conducting polymers, which have only been available for a few years, have successfully been used to, at least partially, solve one of the fundamental problems of semiconductor photoelectrochemistry, namely photocorrosion of small bandgap semiconductor photoelectrodes. The high electronic conductivity in combination with large surface area imply unique possibilities for surface modification. Incorporation of catalysts in the electronically conducting polymer opens up new possibilities for directing photoprocesses to fuel production. And, finally, even though some properties of conducting polymers render them interesting for active photovoltaic energy conversion in electrochemical systems, the low rate of photogeneration of charge carriers is still a limiting problem. 61 references, 5 figures.

0802 Storage

REFER ALSO TO CITATION(S) 28008, 28040

09 OTHER SYNTHETIC AND NATURAL FUELS

0901 Hydrocarbon Fuels

REFER ALSO TO CITATION(S) 27831

28012 **(BNL—34510) Flash pyrolysis of biomass with reactive and non-reactive gases.** Steinberg, M.; Fallon, P.T.; Sundaram, M.S. (Brookhaven National Lab., Upton, NY (USA)). Mar 1984. Contract AC02-76CH00016. 26p. NTIS, PC A03/MF A01; GPO Dep. Order Number DE84011545.

The process chemistry of the flash pyrolysis of biomass (wood) with the reactive gases, H_2 and CH_4 and with the non-reactive gases He and N_2 is being determined in an 1" downflow tubular reactor at pressures from 20 to 1000 psi and temperatures from 600 to 1000°C. With hydrogen, flash hydropyrolysis leads to high yields of ethylene, benzene and CO which can be used for the production of valuable chemical feedstocks and methanol transportation fuel. At reactor conditions of 50 psi and 1000°C and approximately 1 sec residence time, the ethylene yield based on pine wood carbon conversion is 27%, for benzene it is 25% and for CO the yield is 39%, indicating that over 90% of the carbon in pine is converted to valuable products. Pine wood produces higher yields of hydrocarbon products than Douglas fir wood. The yield of ethylene is 2.3 times higher with methane than with helium or nitrogen, thus indicating a free radical reaction between CH_4 and the pyrolyzed wood. There appears to be no net production or consumption of methane. A preliminary process design and analysis indicate an

economically competitive system for the production of ethylene, benzene and methanol based on the methanolysis of wood. 7 references, 13 figures, 1 table.

28013 (CONF-8209212—) **Proceedings of the DOE contractors' conference on indirect liquefaction.** (USDOE Pittsburgh Energy Technology Center, PA). 1982. 369p. NTIS, PC A16/MF A01; 1; GPO Dep. Order Number DE84005786.

From DOE contractors' conference on indirect liquefaction; Pittsburgh, PA, USA (8 Sep 1982).

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The DOE Contractors' Conference on Indirect Liquefaction was held September 8-9, 1982, Pittsburgh, Pennsylvania all 14 papers from the proceedings have been entered individually into EDB and ERA. (LTN)

28014 (CONF-8209212—, pp 1.1-1.17) **Zeolite supported Ru in the F-T synthesis: effect of zeolite type.** Goodwin, J.G. Jr.; Chen, Y.W.; Wang, H.T.; Shyu, J.Z. (Univ. of Pittsburgh, PA). 1982. NTIS, PC A16/MF A01. Order Number DE84005786. Contract FG22-81PC40774. TI84005786

From DOE contractors' conference on indirect liquefaction; Pittsburgh, PA, USA (8 Sep 1982).

The effect of zeolite supports on the properties of Ru F-T catalysts has been studied. Ion-exchanged Ru catalysts were prepared using NaX, NaY, HY, KL, and NaMordenite have been characterized by IR, ESCA, and chemisorption and studied under F-T synthesis. The suppression of hydrogen chemisorption was found to be a strong function of the Si/Al ratio. Methane selectivity, however, seemed to be strongly influenced by the type and concentration of alkali cations remaining in the ion-exchanged zeolite. Some important factors which may affect the properties of a zeolite-supported metal catalyst are listed. 9 references, 4 figures, 2 tables.

28015 (CONF-8209212—, pp 2.1-2.44) **Particle synthesis and properties of zeolite catalysts for synthesis gas - gasoline conversion.** Dodwell, G.W.; Sand, L.B. (Worcester Polytechnic Inst., MA). 1982. NTIS, PC A16/MF A01. Order Number DE84005786. TI84005786

From DOE contractors' conference on indirect liquefaction; Pittsburgh, PA, USA (8 Sep 1982).

This study involves the preparation and evaluation of bifunctional ZSM-5 based Fischer Tropsch catalysts. The first objective was to investigate the P, T, X, t parameters involved in the synthesis of ZSM-5 to delineate the conditions under which a wide variety of ZSM-5 type catalysts could be hydrothermally crystallized. Depending on the system, uniformly sized ZSM-5 crystals were obtained over a widely varient size range from submicron to 180 micrometers exhibiting a number of different crystal morphologies. To evaluate the properties of these catalysts, an integrated computerized zeolite laboratory was designed and implemented.

28016 (CONF-8209212—, pp 3.1-3.21) **Liquid hydrocarbon fuels from syngas.** Eschenbach, R.; Rabo, J. (Union Carbide Corp., Tarrytown, NY). 1982. NTIS, PC A16/MF A01. Order Number DE84005786. Contract AC22-81PC40077. TI84005786

From DOE contractors' conference on indirect liquefaction; Pittsburgh, PA, USA (8 Sep 1982).

The production of midbarrel (turbine and diesel) boiling range hydrocarbons is possible from both methanol and propylene by the use of new Union Carbide molecular sieves. The Union Carbide molecular sieve UCC-104 is able to convert propylene to C_6^+ liquid consisting mainly of gasoline in near quantitative yield (> 95% selectivity). Several superior shape selective catalysts are now available for the formulation of catalysts for the direct conversion of syngas either to gasoline or to turbine and diesel oil.

28017 (CONF-8209212—, pp 4.1-4.15) **Fischer-Tropsch slurry catalyst development.** Diffenbach, R. 1982. NTIS, PC A16/MF A01. Order Number DE84005786. TI84005786

From DOE contractors' conference on indirect liquefaction; Pittsburgh, PA, USA (8 Sep 1982).

A microreactor study is reported for developing iron-based Fischer-Tropsch catalysts for use in a slurry reactor. It is assumed that the slurry reactor is the first stage of a two stage process for gasoline production. The preparation of the catalyst, their reduction and carbiding are described as well as performance results. The authors aim to minimize the production of CH_4, and C_2-C_4 saturates, to upgrade C_2-C_4 olefins to gasoline over ZSM-5 and crack heavy hydrocarbons. (LTN)

28018 (CONF-8209212—, pp 5.1-5.30) **Investigation of sulfur-tolerant catalysts for selective synthesis of hydrocarbon liquids from coal-derived gases.** Rankin, J. (Brigham Young Univ., Provo, UT). 1982. NTIS, PC A16/MF A01. Order Number DE84005786. TI84005786

From DOE contractors' conference on indirect liquefaction; Pittsburgh, PA, USA (8 Sep 1982).

This work is a systematic investigation of catalyst metal-additive and metal-support interactions and their effects on activity, selectivity, and resistance to sulfur poisoning in Fischer-Tropsch synthesis. The major objectives are three-fold: First, to investigate the effects of supports and of sulfur, nitrogen, and boron additives on the activity and selectivity of cobalt and iron catalysts and their sulfur tolerance in CO/H_2 synthesis. Second, to correlate these activity/selectivity and sulfur tolerance properties with measureable properties of the active phases such as oxidation state, dispersion, and adsorption capacities. Third, with this basic understanding, to seek more active, sulfur tolerant iron and cobalt catalysts for selective synthesis of premium hydrocarbon feedstocks. Figure 1 shows the 28 catalysts to be prepared and characterized. This experimental grid was designed to systematically investigate effects of alkali promoters and boron, nitrogen, and sulfur additives and the effects of five support materials, including the novel zeolites ZSM-5 and Silicalite. The preparation of boride promoted catalysts has been refined in our laboratory, and utilizes the reactions shown in Figure 2. Catalyst characterization plans involve a comprehensive, multitool approach to the measurement of basic physical, chemical, and surface properties, and include adsorption measurements, temperature programmed desorption, and analysis by Moessbauer spectroscopy. Once the catalysts have been characterized, they are tested in a laboratory reactor to determine activity/selectivity properties.

28019 (CONF-8209212—, pp 6.1-6.14) **Metal speciation in Fe/ZSM-5 and Co/ZSM-5 relating to synthesis gas and ethylene conversion.** Stencel, J. 1982. NTIS, PC A16/MF A01. Order Number DE84005786. TI84005786

From DOE contractors' conference on indirect liquefaction; Pittsburgh, PA, USA (8 Sep 1982).

28020 (CONF-8209212—, pp 9.1-9.26) **Impact of developing technology on indirect liquefaction.** Gray, D. (Mitre Corp., McLean, VA). 1982. NTIS, PC A16/MF A01. Order Number DE84005786. TI84005786

From DOE contractors' conference on indirect liquefaction; Pittsburgh, PA, USA (8 Sep 1982).

This paper has investigated advanced gasification systems and the Kolbel liquid slurry phase reactor as alternatives to dry ash Lurgi gasification and fast, fluid-bed Synthol reactors used at SASOL. This combination has shown in concept the potential for significant advantages in output, product cost, plant construction cost, liquid product selectivity and overall plant thermal efficiency. Performance data for the advanced components have been derived from pilot scale operations. If the assumed level of component performance is achieved in a plant designed for all-liquid output, advanced gasifiers offer an increase in output with no increase in capital costs. This performance translates to an 18-percent decrease in gasoline production cost. Advanced gasifiers plus Kolbel synthesis offer an increase in output averaging 36 percent, resulting in a decrease in gasoline production cost approaching 33 percent. The efficiency advantages offered by advanced gasifiers in plants employing conventional Fischer-Tropsch reactors can be further improved by combining the advanced gasifiers with an alternative synthesis system such as the slurry phase Kolbel reactor. This additional improvement stems partly from a synergism which results from the ability of the Kolbel reactor to accept the low H_2/CO ratio synthesis gas produced by the advanced gasifiers. However, the most significant advantage of the Kolbel reactor stems from its greater selectivity toward the synthesis of gasoline. These advantages are clearly worth pursuing by supporting R & D in the synthesis area

in slurry phase reactors, slurry compatible catalysts, scaling characteristics and modifications in product output towards diesel and jet fuels. The successful demonstration of this slurry technology would confirm the attractiveness of this Fischer-Tropsch option. 6 references, 5 figures, 5 tables.

28021 (CONF-8209212—, pp 10.1-10.36) **Two-stage slurry Fischer-Tropsch/ZSM-5 process of converting syngas to high octane gasoline.** Kuo, J.C.W. (Mobil Research and Development Corp., Paulsboro, NJ). 1982. NTIS, PC A16/MF A01. Order Number DE84005786. TI84005786

From DOE contractors' conference on indirect liquefaction; Pittsburgh, PA, USA (8 Sep 1982).

Slide No. 2 summarizes the status of this project to date. The design and construction phases of the pilot plant are now complete. The pilot plant has been successfully shaken down and is now fully operational. One slurry F-T catalyst, designated I-A (Fe/Cu/K_2CO_3), has been evaluated using the pilot plant. Currently, a second F-T catalyst, designated I-B (Fe/Cu/K_2CO_3), is being evaluated and has demonstrated high activity and stability over forty days. The operational results of the later run are reported here. We also significantly improved the mathematical model of the slurry F-T reactor. Some details of this model and its application are reported. 3 references.

28022 (CONF-8209212—, pp 11.1-11.19) **Fischer-Tropsch synthesis in slurry reactor systems.** Satterfield, C.N.; Huff, G.A. Jr.; Stenger, H. (Massachusetts Inst. of Tech., Cambridge). 1982. NTIS, PC A16/MF A01. Order Number DE84005786. Contract FG22-81PC40771. TI84005786

From DOE contractors' conference on indirect liquefaction; Pittsburgh, PA, USA (8 Sep 1982).

A slurry-bed reactor for the Fischer-Tropsch synthesis offers several potential advantages over alternative modes of operation. These include the ability to operate at lower H_2/CO ratios, which can reduce the cost of preparing synthesis gas; excellent temperature control, the potential of achieving high conversion in a single pass, and a commercial reactor of simple construction. One objective of the proposed research is to establish a quantitative understanding of the mass transfer-related factors that determine selectivity and reaction rate in such a reactor. In addition, our mechanically-stirred autoclave can be operated as an isothermal CSTR, which provides a unique method of reliably comparing and contrasting different catalysts. As the result of some of our analyses, we conclude that the ability of a slurry-type Fischer-Tropsch reactor to process satisfactorily a feed synthesis gas of low H_2/CO ratio is intimately associated with a high degree of mixing in the reactor and the use of a catalyst active for the water-gas shift reaction. It is notweorthy that when the feed ratio exceeds the usage ratio in such a reactor, the highest degree of conversion results in the highest ratio of dissolved H_2 to CO in the liquid. This should minimize the extent of carbon formation and catalyst disintegration caused by disproportionation of CO. Thus high conversion is desired not only for economic performance but also to help maintain catalytic activity. This study is summarized in a paper by Satterfield and Huff (Can. J. Chem. Eng., 60, 159 (1982)).

28023 (CONF-8209212—, pp 12.1-12.31) **Catalyst and reactor development for a slurry phase Fischer-Tropsch process.** Dyer, P.N. (Air Products and Chemicals, Inc., Allentown, PA). 1982. NTIS, PC A16/MF A01. Order Number DE84005786. Contract AC22-80PC30021. TI84005786

From DOE contractors' conference on indirect liquefaction; Pittsburgh, PA, USA (8 Sep 1982).

Baseline slurry phase tests utilizing an ammonia synthesis catalyst have verified the slurry reactor design and operation, indicated standard Schulz-Flory hydrocarbon product distributions for $CO/H_2 \leqq 1.4$, and served as the basis for a preliminary reactor model. Significant mass transfer limitation of conversion was observed at $T \geqq 280°C$. Slurry phase tests of modified conventional Fischer-Tropsch catalysts have shown that it is possible to overcome the limitations on the yield of fuel product fractions, previously thought to be imposed by the standard Schulz-Flory distribution. Work is in progress to maximize the activity of selective catalysts for the production of diesel fuel range hydrocarbons. Gas phase screening tests of supported metal cluster catalysts have shown that metal-support interactions can alter the production type. Slurry phase tests of selected, supported metal cluster catalysts have indicated the maintenance of activity, and confirmed the variation of product selectivity. The potential exists therefore to design catalysts incorporating both product type and carbon number selectivity. Cold flow modelling studies have indicated a decrease in gas holdup with decreasing particle size and increasing slurry solids loading, and nonuniform solids dispersions for particle size $\geqq 50$ μm, under conditions that would be utilized with internal heat transfer. The slurry phase Fischer-Tropsch reactor is ideally suited for producing enhanced yields of material in the C_{10}-C_{20} range without encountering conditions, such as plugging due to wax buildup, that would inhibit the use of a fixed bed or gas entrained solid reactor. High product yields in this range can be successfully accommodated without any interruption in operation and with the use of CO rich syngas.

28024 (CONF-8209212—, pp 13.1-13.19) **Kinetic study using an iron Fischer-Tropsch catalyst.** Chen, T.Y. (UOP, Inc., Des Plaines, IL). 1982. NTIS, PC A16/MF A01. Order Number DE84005786. TI84005786

From DOE contractors' conference on indirect liquefaction; Pittsburgh, PA, USA (8 Sep 1982).

28025 (CONF-8209212—, pp 14.1-14.24) **Catalyst parametric studies.** Pennline, H. 1982. NTIS, PC A16/MF A01. Order Number DE84005786. TI84005786

From DOE contractors' conference on indirect liquefaction; Pittsburgh, PA, USA (8 Sep 1982).

28026 **(DOE/CS/15059—T1) Sulfur removal from producer gas. Final report.** Lutz, E.J. Jr.; Erickson, D.C.; Tullier, M.J.; Reinhold, H. (Energy Concepts Co., Annapolis, MD (USA)). Jan 1984. Contract FG01-81CS15059. 56p. NTIS, PC A04/MF A01; 1; GPO Dep. Order Number DE84012411.

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This is the final report of research accomplished on this project which entails the establishment of the technical and economic feasibility of a hot fuel gas desulfurization process. The process is designed to provide sulfur removal from producer or synthesis gas at high temperature, while conserving gas stream energy, producing a low volume by-product (sulfur) and not requiring large volumes of treatment materials or producing large volumes of waste materials. This process is accomplished in two stages which may consist of a series combination of either two molten alkali carbonate salt baths or a molten salt stage for the initial H_2S removal followed by an oxygen regenerable sulfur scrubber (ORSS) stage which removes most of the remaining H_2S. The research consisted of five tasks: (1) a thermodynamic analysis to determine the thermodynamic characteristics of both the molten salt sulfur scrubber and the metal/metalate oxygen regenerable sulfur scrubber; (2) the development of a baseline flowsheet for the process and simulation of the process by computer model; (3) the design and operation of a bench-scale model of the double chambered molten salt reactor, utilizing data obtained from a cold hydraulic model of the reactor; (4) the conduct of three series of laboratory experiments to confirm operability of key aspects of the process and to verify that the thermodynamic analysis is valid representation of process chemistry; and (5) an engineering analysis of other important aspects of process viability that are not amenable to experimentation at this level of effort. The results verify the technical feasibility of this method of sulfur scrubbing, and provide a basis for defining the future research which will be necessary in order to verify the economic and commercial viability of the process.

28027 **(DOE/ER/04463—7) Crystallite size and support effects on CO hydrogenation reactions. Final progress report, January 1, 1982-August 30, 1984.** Vannice, M.A. (Pennsylvania State Univ., University Park (USA). Dept. of Chemical Engineering). Feb 1984. Contract AC02-77ER04463. 17p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE84012474.

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TiO_2-supported Pd was found to be the most active Pd methanation catalyst yet reported. However, in-situ IR studies showed that almost no IR-active CO was present on the Pd surface during reaction. During this time, similar results were found for Pt, as Pt/TiO_2 catalysts were found to be 100 times more active than Pt/SiO_2 catalysts and 10 times more active than Pt/Al_2O_3 and Pt/SiO_2-Al_2O_3 catalysts. Again surface concentrations of IR-active CO were barely detectable under reaction conditions. Both H_2 and CO chemisorption measurements were conducted on these catalysts. The surface concentrations of CO under reaction conditions indicated that only a small fraction (1-2%) of the TiO_2-supported metal surface was covered by CO. As a consequence, a modified model for the methanation reaction was proposed, and it was inferred from the studies on Pt and Pd that only a small fraction of the surface metal atoms constitute active sites which create these higher activities.

28028 (DOE/ET/10664—T1) Transition metal cluster complexes as catalysts for the conversion of coal-derived synthesis gas into organic feedstocks and fuels. Semiannual research report. Geoffroy, G.L. (Pennsylvania State Univ., University Park (USA). Dept. of Chemistry). 1 Mar 1979. Contract FG01-77ET10664. 5p. NTIS, PC A02/MF A01; GPO Dep. Order Number DE84012420.

The overall goal of this research is to develop selective and efficient catalysts for the conversion of coal-derived synthesis gas into useful organic feedstocks and fuels. The specific objectives are to conduct a thorough evaluation of a variety of metal clusters for their ability to catalyze reduction of CO, to optimize the reaction conditions for these clusters which are identified as catalysts, and to develop a thorough understanding of the interactions of CO and H_2 on transition metal clusters. Initial efforts have been devoted to establishing the reaction conditions and analytical procedures necessary to evaluate the ability of specific metal carbonyl clusters to catalyze reduction of CO. The following clusters were found to decompose at 100°C under one atmospheric pressure of a 3/1-H_2/CO gas mixture and no organics were detected: $Fe_3(CO)_{12}$, $H_2FeRu_3(CO)_{13}$, $HCoRu_3(CO)_{13}$, $CH_3CCo_3(CO)_9$, and $PhCCo_3(CO)_9$. However $Os_3(CO)_{12}$ catalyzed the reaction to yield substantial amounts of methane, with small amounts of ethane and other low-molecular weight hydrocarbons.

28029 (DOE/ET/10664—T2) Transition metal cluster complexes as catalysts for the conversion of coal-derived synthesis gas into organic feedstocks and fuels. Final technical report. Geoffroy, G.L. (Pennsylvania State Univ., University Park (USA). Dept. of Chemistry). 13 May 1980. Contract FG01-77ET10664. 5p. NTIS, PC A02/MF A01; GPO Dep. Order Number DE84011787.

Our initial efforts were devoted to establishing the reaction conditions and analytical procedures necessary to evaluate the ability of specific metal carbonyl clusters to catalyze reduction of CO. The first level of evaluation involved heating 3×10^{-3} M isooctane solutions of each cluster to 100°C under one atmosphere pressure of a 3/1-H_2/CO gas mixture. The gases above the samples were periodically analyzed by gas chromatography to determine if any hydrocarbons or CH_3OH had been produced. The following clusters were found to decompose under these conditions and no organics were detected: $Fe_3(CO)_{12}$, $H_2FeRu_3(CO)_{13}$, $HCoRu_3(C)_{13}$, $CH_3CCo_3(CO)_9$, and $PhCCo_3(CO)_9$. $H_4Ru_4(CO)_{12}$ appeared stable under these conditions but no organics were produced. As a check on our analytical procedures, we examined $Os_3(CO)_{12}$ which had been reported to catalyze CO hydrogenation [M.G. Thomas, B.F. Beier, and E.L. Muetterties, J. Am. Chem. Soc., 98, 1296 (1976)]. After heating this cluster to 100° for 24 h under the reaction conditions described above, substantial quantities of methane were observed with small amounts of ethane and other low-molecular weight hydrocarbons also produced.

28030 (DOE/ET/10664—T3) Transition metal cluster complexes as catalysts for the conversion of coal-derived synthesis gas into organic feedstocks and fuels. Annual research report. Geoffroy, G.L. (Pennsylvania State Univ., University Park (USA). Dept. of Chemistry). Sep 1978. Contract FG01-77ET10664. 14p. NTIS, PC A02/MF A01; GPO Dep. Order Number DE84012322.

The overall goal of this research is to develop selective and efficient catalysts for the conversion of coal-derived synthesis gas into useful organic feedstocks and fuels. The specific objectives are to conduct a thorough evaluation of a variety of metal clusters for their ability to catalyze reduction of CO, to optimize the reaction conditions for those clusters which are identified as catalysts, and to develop a better understanding of interactions of CO and H_2 on metal surfaces through model studies with metal clusters. Progress reports are presented for the following tasks: (1) evaluation of clusters as homogeneous catalysts for carbon monoxide reduction; (2) reaction of metal carbonyl clusters with CO; (3) metal clusters as precursors for supported heterogeneous catalysts; and (4) metal clusters as models for Fischer-Tropsch and methanol synthesis catalysts. 4 references.

28031 (EPRI-AP—3426) Transportation and handling of medium Btu gas in pipelines. Final report. McCarrick, A.T.; Nguyen, P.N.; Shenoy, T.A.; Sorensen, J.C. (Air Products and Chemicals, Inc., Trexlertown, PA (USA)). Mar 1984. 118p. EPRI-RRC, Box 50490, Palo Alto, CA 94303. Order Number DE84920332.

This report examines and discusses the pipeline transportation of clean, dry, ambient temperature Medium Btu Gas (MBG). The Medium Btu Gas considered here is that typically produced from entrained flow and moving bed type coal gasification processes. The subject matter of the study includes a discussion of the toxic and corrosive characteristics of the Medium Btu Gas, major potential causes and modes of pipeline failure and the various considerations involved in the safety and design, construction, operation and maintenance of Medium Btu Gas pipelines. Also discussed throughout the report are the applicable Federal Regulations that govern the pipelining of Medium Btu Gas, and additional voluntary features that could enhance the safety of pipelining MBG. This report is intended only to provide background information and general guidance, and should not be used directly for the evaluation, design, construction, operation and maintenance of Medium Btu Gas pipelines. Such activities should be performed by experienced organizations on a case by case basis. 37 references, 20 figures, 1 table.

28032 (PB—84-156413) Commercial potential of wood gasification and its application in New York state. Final report. Miller, B.; Glass, M.W.; Smythe, A. (Hart (Fred C.) Associates, Inc., Washington, DC (USA)). Sep 1983. 155p. NTIS, PC A08/MF A01.

This report describes low-Btu wood gasification technology for boiler retrofit, the wood supply situation in New York State, the economics of wood gasification in typical applications, and environmental aspects of the use of wood for fuel. Comparisons are made among natural gas, distillate fuel oil, 6 fuel oil, and low-Btu wood gas. The report indicates that wood gasification would be profitable for firms and institutions with moderate to high load factors located within 50 miles of a wood supply.

28033 (PB—84-162718) Chemical reclamation of scrap rubber. Final report. Frazier, G.C.; Chan, S.M.; Culberson, O.L.; Perona, J.J.; Larsen, J.W. (Tennessee Univ., Knoxville (USA)). Jan 1984. 83p. NTIS, PC A05/MF A01.

A conceptual, commercial-scale plant design was formulated for processing 22,500 t/yr of scrap rubber tires to hydrocarbon fuel gases, oils, petrochemicals (principally ethylene and aromatic liquids), and carbon black. The process is based upon molten salt (zinc chloride) pyrolysis of the rubber, and pyrolysis data obtained in a bench-scale flow apparatus. An economic assessment of the plant was made in terms of late 1979 dollars, for ranges in scrap tire costs and prices for the principal products: carbon black and the fuel gases and oil. Profitability at these 1979 costs and prices is somewhat modest by chemical processing industry standards for new processes, but any increases in energy and carbon black prices would cause favorable changes in this assessment.

28034 **(PB—84-162981) Review of the potential for biomass resources and conversion technology. Final report, Jan-Jul 83.** Lipinsky, E.S.; Jenkins, D.M.; Young, B.A.; Sheppard, W.J. (Battelle Columbus Labs., OH (USA)). Jul 1983. 215p. NTIS, PC A10/MF A01.

Biomass resources include dedicated energy crops, forestry/agricultural residues, and certain organic fractions of wastes. The magnitude of the resource base, the extent to which it can be devoted to methane production, the quantity of methane that can be produced, and the cost of the methane are issues that are addressed in this study. Research needs include improvement of agricultural production methods, especially regarding problems caused by the seasonal nature of biomass production. Reduction of capital investment per unit of methane could be achieved by development of membrane gas clean up systems or combination biomass storage/fermentation systems, are examples of advanced technologies.

28035 **(PNL-SA—11891) Upgrading biomass liquefaction products through hydrodeoxygenation.** Elliott, D.C.; Baker, E.G. (Pacific Northwest Lab., Richland, WA (USA)). May 1984. Contract AC06-76RL01830. 29p. (CONF-840509—1). NTIS, PC A03/MF A01; GPO Dep. Order Number DE84011898.

From 6. symposium on biotechnology for fuels and chemicals; Gatlinburg, TN, USA (1 May 1984).

Products of direct liquefaction of wood at high pressure have been converted by catalytic hydrogenation to a gasoline-like hydrocarbon product. The process operates at a temperature of 300° to 350°C and a pressure of 2000 psig with nickel metal or sulfided cobalt-molybdenum catalyst. The catalysts are commercially available hydrotreating catalysts. Other tests have shown a copper-chromite catalyst and the unsulfided form of the cobalt-molybdenum catalyst to be less effective. Analysis by infrared spectrophotometry, gas chromatography/mass spectrometry and nuclear magnetic resonance in addition to determination of elemental composition, density and distillation range were used to evaluate the product composition. 28 references, 7 figures, 5 tables.

28036 **(PNL-SA—12026) DOE's biomass thermochemical conversion program: current research status and prospects for technology transfer.** Schiefelbein, G.F.; Stevens, D.J. (Pacific Northwest Lab., Richland, WA (USA)). Apr 1984. Contract AC06-76RL01830. 10p. (CONF-840493—1). NTIS, PC A02/MF A01; GPO Dep. Order Number DE84011879.

From Energy from biomass technical review meeting; Portland, OR, USA (23 Apr 1984).

The US Department of Energy (DOE) is actively developing renewable energy sources through research and development programs sponsored by the Biomass Energy Technology Division. Through research sponsored by its Thermochemical Conversion Program, DOE is studying advanced methods of using thermal energy to generate high value gaseous and liquid fuels as well as heat and electricity. Field management for the Thermochemical Conversion Program is provided by Pacific Northwest Laboratory (PNL) which has been designated the Lead Laboratory for the Program since 1980. Research currently sponsored by the Thermochemical Conversion Program can be divided into three technology areas; gasification, liquid fuels production, and innovative combustion processes. Gasification research is directed primarily toward the production of medium-energy gases which could be used as fuel gases or as synthesis gases. The primary emphasis of current combustion research is determining the feasibility of directly using biomass feedstocks to power gas turbine systems. Liquid fuels research is directed toward the utilization of pyrolysis and direct liquefaction techniques to generate a variety of olefinic and aromatic hydrocarbon fuels. Prospects for technology transfer of selected research projects is discussed.

28037 **(PNL-SA—12260) Thermochemical gasification of high-moisture biomass feedstocks.** Sealock, L.J. Jr.; Elliott, D.C. (Pacific Northwest Lab., Richland, WA (USA)). May 1984. Contract AC06-76RL01830. 17p. (CONF-8405157—1). NTIS, PC A02/MF A01; GPO Dep. Order Number DE84011880.

From 16. biomass thermochemical conversion contractors meeting; Portland, OR, USA (8 May 1984).

A new project was initiated at Pacific Northwest Laboratory (PNL) in January 1984 which has the potential for significant advantages over conventional thermochemical and biological conversion technologies. The objective of this project is to investigate the feasibility of using a low-temperature (250 to 450°C), high pressure (up to 5000 psi) slurry reactor system for converting high-moisture biomass to gaseous (methane and synthesis gas) and liquid fuels. Emphasis will be placed on conditions favoring gasification and methane formation. However, some conditions being studied may favor liquid production and are required to develop a full understanding of the process chemistry. Catalysts and reactants to be employed singularly or in combination in the investigations include sodium carbonate, nickel or other metals, and CO. Feedstocks selected for investigation are those not previously attractive for thermochemical conversion and would require dewatering before they could be converted in ore typical thermochemical conversion systems. Several candidate feedstocks have been identified and two feedstocks (water-hyacinths and potato processing waste) have been obtained and characterized. Procurement of additional samples is in progress. Installation of the 1.0 liter autoclave and experimental system began in April. Feedstock screening tests are scheduled for June 1984. 3 references, 3 figures, 1 table.

28038 **Iron alloy Fischer-Tropsch catalysts. 4. Reaction and selectivity studies of the FeCo system.** Arcuri, K.B.; Schwartz, L.H.; Piotrowski, R.D.; Butt, J.B. (Northwestern Univ., Evanston, IL). *Journal of Catalysis;* **85**: No. 2, 349-361(Feb 1984). Contract AC02-78ER04993.

Iron-cobalt alloys have been reported to have enhanced C_2-C_3 selectivity in the synthesis reaction for both supported and unsupported materials. Much of the available data are, however, at total pressures of 1 atm and low conversions. This study presents results obtained with a representative $FeCo/SiO_2$ catalyst in comparison with the supported pure metal components at 523°K and pressures up to 14 atm. Major results are that the conversion dependence of selectivity noted at 1 atm is suppressed at higher pressures and the iron-containing materials become good methanol producers at higher pressures, largely at the expense of methane formation. In terms of CO conversion the alloy catalyst resembles Fe/SiO_2 at atmospheric pressure and Co/SiO_2 at higher pressure; however, for oxygenate production just the opposite pertains. The enhanced olefin selectivity for $FeCo/SiO_2$, observed previously in experiments at atmospheric pressure, is not maintained at higher pressures.

28039 **Evidence for two chain growth probabilities on iron catalysts in the Fischer-Tropsch synthesis.** Huff, G.A. Jr.; Satterfield, C.N. (Massachusetts Inst. of Tech., Cambridge). *Journal of Catalysis;* **85**: No. 2, 370-379(Feb 1984). Contract FG22-81PC40771.

New data and reexamination of several previous studies in either fixed bed or slurry liquid reactors with iron catalysts show that the products frequently may be characterized as the sum of two Flory carbon number distributions. In many cases the dominating distribution shifts at about C_{10}. At higher carbon numbers hydrocarbons are produced with a much higher probability of chain growth than for lower carbon numbers. Results are interpreted in terms of a two-site catalyst structure.

28040 **Support effects on CO hydrogenation over Ru/zeolite catalysts.** Chen, Y.W.; Wang, H.T.; Goodwin, J.G. Jr. (Univ. of Pittsburgh, PA). *Journal of Catalysis;* **85**: No. 2, 499-508(Feb 1984). Contract FG22-81PC40774.

Hydrogenation of carbon monoxide at 101.3 kPa has been studied over a series of ion-exchanged Ru catalysts supported on NaX, NaY, KL, Na mordenite, and HY zeolites. The type of zeolite had pronounced effects on the activity and selectivity of the Ru. The specific activity would appear to be related to the dispersion of reduced ruthenium in the zeolite. Methane selectivity, however, seems to be strongly influenced by the type and concentration of alkali cations remaining in the ion-exchanged zeolite. These cations appear to promote chain growth much as traditional alkali promoters would, though perhaps more indirectly. Due to bifunctional properties of the zeolite-supported catalysts, a significant fraction of C_4 was in the form of isobutane. Formation of isobutane

seems to be related to either the Si/Al ratio in the zeolites or the concentration of the remaining alkali cations, but not to the OH concentration. In addition, H_2 chemisorption at 25°C was increasingly suppressed as the Se/Al ratio of the zeolite support increased. Both the formation of isobutane and the suppression of H_2 chemisorption may be related to the acid strength of the OH groups present, which is a function of the Si/Al ratio of the zeolite.

28041 **Low valent actinides as hydrogenation catalysts.** Moody, D.C.; Paine, R.T. (Los Alamos National Lab., NM). *Journal of Catalysis;* **85**: No. 2, 536-537(Feb 1984).

The preparation of an olefin hydrogenation catalyst containing uranium is described. Reduction of UCl_4 with lithium aluminum hydride in tetrahydrofuran (THF) produces UCl_3THF as a transient species which ultimately precipitates as a black pyrophoric solid. Adsorption of the UCl_3THF onto γ-alumina prior to reduction with $LiAlF_4$ yields a reproducible catalyst. Characterization of the uranium-containing catalyst is almost impossible because of its reactivity. Data are presented to demonstrate a moderate activity of the catalyst with ethylene and cyclohexene hydrogenation at room temperature to ethane and cyclohexane, respectively.

0902 Alcohol Fuels

REFER ALSO TO CITATION(S) 28519, 28721, 28723

28042 (CONF-8209212—, pp 7.1-7.50) **Liquid-phase methanol PDU-project status and plan.** Klosek, J.; Mednick, L. (Air Products and Chemicals Inc., Allentown, PA; Chem Systems Inc., Tarrytown, NY). 1982. NTIS, PC A16/MF A01. Order Number DE84005786. TI84005786

From DOE contractors' conference on indirect liquefaction; Pittsburgh, PA, USA (8 Sep 1982).

LPMeOH technology has the potential to be a more efficient, lower-cost conversion route to methanol-from-domestic coal than current gas-phase processes. Laboratory work to date shows LPMeOH technology particularly suited to coal-derived synthesis gas rich in carbon monoxide because: it is capable of processing feed gas of varying CO and H_2 contents; it results in higher CO conversion per pass; and it permits more effective recovery of heat liberated during reaction. During Phase I of the program, Air Products conducted a detailed engineering review of the originally proposed plan for installation of the LPMeOH PDU. The review included: establishment of the LaPorte LPMeOH PDU process design basis and a process flowsheet; review of existing equipment from the LPM unit; evaluation of permit requirements and exemption from an environmental air permit; performance of a process hazards review; preparation of process equipment specifications, mechanical purchase specifications, a preliminary engineering flowsheet, and semi-final equipment arrangement and plot plan drawings compiling much of the review data. The latter engineering drawings and documents formed the basis for a detailed cost estimate for engineering, equipment, and renovation/installation of the LaPorte LPMeOH PDU. Chem Systems completed successful testing and optimization of liquid phase (in-situ) catalyst reduction procedures. A major milestone was accomplished with completion of a 540-hour liquid-fluidized (ebullated bed) run in the Lab PDU at Fairfield, using a new, improved catalyst. The activity of the successful catalyst was 25 to 80% higher than the best prior catalyst, and the resistance to activity loss over the short term was approximately 3 times better. 6 references, 8 figures, 14 tables.

28043 (CONF-8209212—, pp 8.1-8.18) **Status of the 100 B/D fluid-bed methanol-to-gasoline (MTG) project.** Lee, W. (Mobil Research and Development Corp., Paulsboro, NJ). 1982. NTIS, PC A16/MF A01. Order Number DE84005786. TI84005786

From DOE contractors' conference on indirect liquefaction; Pittsburgh, PA, USA (8 Sep 1982).

Construction of the 100 BPD MTG plant in Wesseling, Germany has now been completed and plant shakedown is now underway. A simplified flow diagram of the plant is shown in Figure 8. The reactor, catalyst cooler, and regenerator section is the same as the CFM. Commercial grade methanol is mixed with boiler feed water (to simulate crude methanol) and it is vaporized and superheated to 350°F. The reactor effluent is scrubbed of any catalyst fines and condensed. The aqueous product is separated from the hydrocarbons in the separator. The C_4^- fraction is removed from the gasoline product in a debutanizer. The operating conditions of major system components are shown in Table 2. The shakedown period will last about 3 to 4 months. The unit will be put on-stream late this year or early next year. A 21-month operating period is planned. It will include testing of external catalyst cooling and internal catalyst cooling. We plan to demonstrate steady state operation, with maximum gasoline yield and minimal catalyst requirements. The product testing will be carried out both in Germany and in the US. The program will culminate in a conceptual design of a commercial size fluid-bed MTG plant. 8 figures, 2 tables.

28044 **(DOE/ER/10265—1) Biomass fermentation technology, Project No. 1. Final performance report. Cooperative research and training in biomass conversion and utilization.** (Auburn Univ., AL (USA)). 1 Mar 1984. Contract FG05-81ER10265. 11p. NTIS, PC A02/MF A01; GPO Dep. Order Number DE84011594.

The DOE sponsored cooperative research and training program in biomass conversion and utilization initiated a program between Auburn University and the Tennessee Valley Authority which is in its third year. The program was initiated to train students in biomass fermentation and to further the technology for conversion of wood sugars to alcohol fuels. Three students have earned graduate degrees - two M.S. and one Ph.D. The research conducted by the students contributed to the development of TVA's process of wood sugar conversion to ethanol. Research accomplishments were in the utilization of first stage hydrolyzate. Two fermentations, ethanol and 2,3-butanediol, have been shown through preliminary studies and published reports to be best adaptable to wood sugar conversion. Production of ethanol from first stage hydrolyzate was accomplished with the yeast Pachysolen tannophilus NRRL Y-2640. Saccharomyces uvarum was used to ferment sugars in second stage hydrolyzate to ethanol. A bacterium (AUI-D3N) isolated at Auburn University was used to produce 2,3-butanediol. Pachysolen tannophilus and culture AUL-D3N ferment pentose and hexose sugars while Saccharomyces uvarum ferments only hexose sugars. From purified sugars, the organisms produce yields of ethanol or 2,3-butanediol which are greater than 74% of theoretical. Studies were conducted to evaluate possible inhibitory effects of phenolic compounds, acetic acid and furfural on growth and ethanol production by Pachysolen tannophilus. Initial studies showed sulfuric acid hydrolyzed wood was very toxic to AUI-D3N (2,3 butanediol biosynthesis). Calcium hydroxide precipitation of wood hydrolyzate improved growth and 2,3-butanediol production, however, treatment with ion exchange resins proved to be the most effective method for optimizing growth and production. 7 references.

28045 **(DOE/ER/10265—2) Biomass processing and product recovery, Project No. 2. Interim progress report. Cooperative research and training in biomass conversion and utilization.** Placek, T.D. (Auburn Univ., AL (USA)). 1983. Contract FG05-81ER10265. 34p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE84011579.

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The goal of this research is to identify and explore some of the considerations in solvent extraction of ethyl alcohol from fermented wood hydrolyzate. The objectives of the experimental work was to provide batch and cross-current extraction data on common organic solvents and the fermentation broth. The data were necessary to validate the LLEXT program. Beer solutions were prepared in the laboratory to simulate the fermented wood hydrolyzate of southern red oak hardwood. Results show that: batch and cross-current solvent extractions can be simulated successfully using the LLEXT program which incorporates the UNIFAC free-energy model; extractions involving alkanes and aromatics were determined by simulations to rate unsatisfactory at ethyl alcohol recovery, but superior in water rejection and solvent losses; extraction simulations involving acetate solvents rated satisfactory at ethyl alcohol recovery, superior at water rejection and unsatisfactory at solvent losses; a solvent number can be used to predict the optimum number of cross-current solvent extraction stages, considering ethyl alcohol recovery and water rejection only; of the acetates considered as solvents only ethyl acetate and isobu-

tyl acetate had relatively low costs; ethyl acetates boiling point is too low for good separation and recovery of ethyl alcohol via distillation of the extraction product; little or no ethyl alcohol can be separated from isobutyl acetate and MEK extracts in simulated distillations using the parameters specified; the majority of furfural and acetic acid remained with the solvent in the bottoms during simulated distillation using isobutyl acetate and MEK extracts; and simulated distillation of the standard fermentation beer using the parameters specified predicted a product containing less than 6 mole % ethyl alcohol. 4 references, 4 figures, 4 tables.

28046 **(DOE/R7/01157—T1) Bacterial cellulose fermentation. Final technical report.** Vore, R. (Vore (Roy), Pittsburg, KS (USA)). Jan 1982. Contract FG47-80R701157. 17p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE84007847.

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Physical parameters of growth were determined for Zymomonas mobilis ATCC 10988. The pH range was 4.5 to 7.0. Temperature range was 25° to 32°C with 30°C being optimum. Viability is lost between fourteen and twenty days in broths at 30°C. Semisolid media at 23°C maintained viability up to six weeks. Age of seed culture affects length of lag phase and a reduction in viability is noted. The organism is anaerobic. Chemical parameters of growth were studied. Only glucose, fructose and sucrose can be fermented. Only glucose fermentation kinetics were quantified and levels above 100 g/L glucose showed inhibition of growth. Pantothenate is obligately required. High ammonium levels reduced ethanol production. Complex media with yeast extract had higher ethanol production and growth rates. Four liter pilot studies on complex media produced up to 47.5 g/L ethanol from 100 g/L glucose in 20 hours and had a 99.9% theoretical yield. Maximum production rate noted was 2.38 g/L/h. Minimal media had lower yields and rates. Scaleup to 55 gallons proved difficult and was not fully achieved. Mechanical optimization of the vessel was not achieved. Cellulosic hydolysis studies were not attempted and not reported herein. Scale-up and associated problems required much more time than originally anticipated and were still not fully developed.

28047 **(NYSERDA—83-23) Cellulose-ethanol commercialization. Final report.** Malarkey, N. (United Engineers and Constructors, Inc., Philadelphia, PA (USA)). Jan 1984. 41p. NYSERDA, Two Rockefeller Plaza, Albany, NY 12223. Order Number DE84901148.

The status of several technologies for the conversion of cellulose to ethanol was evaluated in terms of commercial readiness. Technologies receiving the greatest attention were acid hydrolysis and enzyme hydrolysis. The conclusion was drawn that if a cellulose-ethanol plant were to be built in the near future, an acid hydrolysis approach would be more likely to be economically viable than an enzyme approach. Profitability will depend on the ability of the process to operate on low-cost feedstocks, separate product streams, and utilize commercially available reactors and other equipment. 2 figures, 2 tables.

28048 **(PB—84-155555) Sale of surplus digester and landfill gas to public utilities.** Cairns, C.A.; Pincince, A.B. (Camp Dresser and McKee, Boston, MA (USA)). Feb 1984. 56p. NTIS, PC A04/MF A01.

Methane gas produced by anaerobic digestion of wastewater sludge can be upgraded to pipeline quality and sold to a public utility for injection into a natural gas distribution system. Upgrading the gas typically involves treatment for removal of carbon dioxide and hydrogen sulfide, dehydration, and compression. Upgrading of digester gas to pipeline quality is technically feasible. Moreover, based on current prices of natural gas, selling of upgraded gas to a public utility is economically viable. Although this method of gas utilization has been investigated for several wastewater treatment plants, no such programs have been implemented. The primary reason is that to date, other alternatives (usually involving on-site uses) have been considered more manageable or economical. Gas generated in solid waste landfills is similar in quality to digester gas. Several landfill gas recovery, processing, and utilization projects (some of which involve selling upgraded gas to a public utility) have either been implemented or are being planned. Because there are no competing on-site uses of landfill gas and because landfill gas quantities are typically much larger than those from digesters, landfill gas has a greater potential for future development by public utilities.

28049 **Method of saccharifying cellulose.** Johnson, E.A.; Demain, A.L.; Madia, A. (to Dept. of Energy). US Patent Application 6-494,482. 13 May 1983. 19p. Contract AC02-77ET20030.

A method is disclosed of saccharifying cellulose by incubation with the cellulase of Clostridium thermocellum in a broth containing an efficacious amount of thiol reducing agent. Other incubation parameters which may be advantageously controlled to stimulate saccharification include the concentration of alkaline earth salts, pH, temperature, and duration. By the method of the invention, even native crystalline cellulose such as that found in cotton may be completely saccharified.

0904 Solid Waste And Wood Fuels

REFER ALSO TO CITATION(S) 29497

28050 **(AD-A—137449/5) Technology evaluation for densified refuse-derived fuel specifications and acquisition. Final report.** Tuck, J.; Savage, G. (Cal Recovery Systems, Inc., Richmond, CA (USA)). Dec 1983. 38p. NTIS, PC A03/MF A01.

This report determines existing and feasible specifications for densified Refuse Derived Fuel (d-RDF) to be used on military installations. The d-RDF specifications are compared to specifications for coal and wood. Site visits to two RDF facilities were conducted. Recommendations on improvements to existing d-RDF specifications are made.

28051 **(DOE/R7/01238—T1) Summary report on the wood waste utilization project under the US Department of Energy Appropriate Energy Technology Small Grants Program.** Grimes, D.P. (Southeast Missouri Regional Planning and Economic Development Commission, Perryville (USA)). Jul 1983. Contract FG47-81R701238. 36p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE84010451.

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This report summarizes activities to promote the use of wood waste as energy within the seven-county Southeast Missouri Region. The history of wood waste projects within the Region is reviewed, the actual activities undertaken are summarized, and a set of lessons learned and conclusions are presented. The primary conclusion is that projects such as this are valuable for rural America in general. These contracts can allow for professional staff to be available to assist in developing alternative energy projects. Such contracts can be reasonably inexpensive for the federal government and can have far reaching effects on the national energy picture by promoting alternate fuels in rural parts of the country. Discussion is presented under the headings: energy audits; barge refitting operation; pellet mill; charcoal operation; wood gasifier project; wood-fired transportation project; municipal electric generation project; and county landfill incineration project.

28052 **Solid waste trial for coal-burning process.** O' Sullivan, D.A. *Chemical and Engineering News;* 57: No. 6, 24(Feb 1979).

Battelle Columbus Laboratories is studying the combustion of municipal solid waste and sewage sludge in its multisolid fluidized-bed process developed for burning coal. If successful, low-pressure steam would be generated for municipal wastewater treatment facilities. In operation, wastes are burned with sand while the mixture is fluidized with air. After leaving the combustor, hot sand is separated and recirculated into an external boiler. There it dries the sludge and vaporizes water to produce steam.

13 HYDRO ENERGY

1301 Resources And Availability

REFER ALSO TO CITATION(S) 28545, 28560

28053 **(EGG-M—09284) Future of hydropower.** Chappell, J.R. (EG and G Idaho, Inc., Idaho Falls (USA)). 11 Apr 1984. Contract AC07-76ID01570. 49p. (CONF-8404140—2). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE84011452.

From Small hydropower workshop; Columbia, MO, USA (10 Apr 1984).

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The paper discusses the history, current status, and resource potential as well as impediments and factors favoring hydropower development in the United States. Future hydroelectric capacity is estimated from Federal Energy Regulatory Commission (FERC) permit and license applications and from several private and government agency projections.

1303 Plant Design And Operation

REFER ALSO TO CITATION(S) 28058, 28474

28054 **(EPRI-EM—3435) Hydropower reliability study. Final report.** (Motor-Columbus Ingenieurunternehmung A.G., Baden (Switzerland); Black and Veatch, Kansas City, MO (USA)). Mar 1984. 596p. EPRI-RRC, Box 50490, Palo Alto, CA 94303. Order Number DE84920354.

A thorough investigation of matters affecting hydroelectric and pumped storage reliability has been performed and is the subject of this report. Although hydroelectric units are highly reliable by comparison to other types of generation, there remains room for improvement. It is estimated that each percentage point of improvement in plant availability and utilization would provide, nationally, net benefits of about $125 million per year. The investigation was pursued using two separate but complementary approaches: (1) the entire North American Electric Reliability Council's data base on hydropower units was analyzed in detail to identify sources of unreliability, and (2) visits were made to a carefully selected group of 28 plants to obtain firsthand information on problems, operation and maintenance practices, and so forth. The large amount of information obtained from the plant visits was analyzed to determine opportunities for improvement. The study has resulted in a series of recommendations which should be helpful to both present and prospective owners and designers of hydroelectric facilities. There are also many specific observations in the detailed sections of the report which will be of interest to many utility personnel and other individuals within the hydropower industry.

1305 Economics And Management

28055 **(DOE/NBM—4012204) Small-scale hydroelectric power: a brief assessment.** (Tudor Engineering Co., Denver, CO (USA)). Feb 1984. 78p. NTIS, PC A05/MF A01; GPO Dep. Order Number DE84012204.

This document discusses small-scale hydroelectric technology, its applications within integrated power systems, the extent of current development, factors affecting future development, the development process, how Western can assist in such development, and some benefits and considerations for small-scale hydroelectric projects. To reflect the potential for small-scale hydroelectric development within Western's power marketing area, an inventory and brief assessment of identified potential project sites by states or portions of states within Western's power marketing area was completed. The results are presented. Several sources for obtaining additional information are identified and contacts for more information are given.

28056 **(PB—84-150671) Economic appraisal of small-scale hydro power projects.** Goldsmith, K. (United Nations Industrial Development Organization, Vienna (Austria)). 5 Aug 1983. 16p. NTIS, PC 03/MF E01.

The report covers (1) preconditions for considering such projects (2) methods of economic appraisal: cost benefit analysis; comparison of present worth of cash flow; internal rate of investment returns; comparison of production costs (3) case study of an economic analysis with reference to a project in Thailand.

1306 Environmental Aspects

28057 **(PB—84-148600) Safety of existing dams: evaluation and improvement. Final report.** (National Academy of Sciences - National Research Council, Washington, DC (USA)). 1984. 377p. NTIS, PC A17/MF A01.

The goal of this report is the enhancement of dam safety. It was prepared by the Committee on the Safety of Existing Dams, NRC to present in a single volume all essential aspects of dam safety. A major objective of the report is to provide guidance for achieving improvements in the safety of existing dams within financial restraints. Many dam owners are faced with problems of such a nature and extent that they are unable to finance remedial measures. To these owners as well as to regulatory agencies and others concerned with the engineering and surveillance of dams, the committee presents its suggestions and guidance for assessing and improving dam safety.

28058 **(TVA/PUB—84/28) Effect of hydro turbine air venting on generating efficiency, dissolved oxygen uptake, and turbine vibrations.** Harshbarger, E.D.; March, P.A.; Vigander, S. (Tennessee Valley Authority, Norris (USA). Div. of Air and Water Resources). Mar 1984. 27p. NTIS, PC A03/MF A01. Order Number DE84901147.

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Low dissolved oxygen (DO) concentrations which occur seasonally in the turbine discharge from multipurpose, tributary reservoirs have stimulated the development of methods to increase the DO with a minimum of unwanted effects on the turbine set. A method is described in which flow deflectors mounted on the hub of a Francis runner are used to aspirate air through pipes in the headcover for all gate openings. Measurements were made of the amount of aspirated air, the efficiency of the oxygen transfer process, the change in generating efficiency, and the change in the vibratory behavior of the turbine set. For comparison, the data are compared to aeration results obtained by forceful injection of air under the headcover. The measuring techniques are described, the resulting data are presented, and the applicability of the reoxygenation method is discussed. 25 references, 5 figures, 3 tables.

1307 Power Conversion Systems

28059 **(EGG-M—09184) New technology for small hydropower installations.** Chappell, J.R. (Idaho National Engineering Lab., Idaho Falls (USA)). 11 Apr 1984. Contract AC07-76ID01570. 40p. (CONF-8404140—1). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE84011180.

From Small hydropower workshop; Columbia, MO, USA (10 Apr 1984).

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A general discussion is presented of new technologies, both hardware and methodologies, that may be used in developing small hydropower installations. The primary source of information is the results of the R/D projects funded under the DOE Small Hydropower Program. The paper is divided into the following categories: turbine/generator, head augmentation, nonconventional concepts, structure and construction, system management, controls, and reconnaissance and feasibility studies. References are provided for obtaining detailed information on the individual projects.

28060 **(EGG-M—09384) Hydropower hardware descriptions .** Chappell, J.R. (EG and G Idaho, Inc., Idaho Falls (USA)). Feb 1984. Contract AC07-76ID01570. 45p. (CONF-8404140—3). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE84011614.

From Small hydropower workshop; Columbia, MO, USA (10 Apr 1984).

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The differences in eleven typs of turbines are discussed; their characteristics are tabulated; and their operating ranges and geometry are illustrated by use of graphs and drawings. The primary conventional types are discussed as well as the new or non-conventional types which have been researched by DOE.

14 SOLAR ENERGY

REFER ALSO TO CITATION(S) 28558

1401 Resources And Availability

REFER ALSO TO CITATION(S) 28624

28061 **(SERI/SP—281-1973) Solar Radiation Data Directory. A guide to solar radiation and meteorological data collection activities in the United States.** (Solar Energy Research Inst., Golden, CO (USA)). Dec 1983. Contract AC02-83CH10093. 147p. NTIS, PC A07/MF A01; 1; GPO Dep. Order Number DE84000095.

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This directory identifies and briefly describes solar radiation and related meteorological data collection activities in the United States, past and present. It provides general availability and contact information. This publication focuses especially on state and local independent efforts which would otherwise remain obscure. While the information presented is not exhaustive, it gives a representative overview of the availability of solar radiation data in each of the 50 states. Besides providing valuable leads to existing stores of data and data collection activities, this directory offers a representative sampling of the kinds of monitoring efforts conducted at the state and local levels, and of the types of organizations and individuals that conduct them. Solar radiation and meteorological data collection activities are classified as state and local efforts, or as national and regional (multistate) monitoring networks. Chapter 2 summarizes over 200 historical and ongoing monitoring programs at the state and local levels. These are arranged alphabetically by responsible agency within each state and include both selected references and contact information for each entry. Chapter 3 presents information in a similar format for 32 national, regional, and multistate monitoring networks, with the entries arranged alphabetically by responsible agency. This section was largely compiled from available literature, particularly for those networks reporting data to state or federal agencies.

1403 Economics

REFER ALSO TO CITATION(S) 28092

28062 **(DOE/RG/06405—T3) New Mexico residential solar rate initiatives. Final report.** (ICF, Inc., Washington, DC (USA)). Dec 1980. Contract AC01-78RG06405. 128p. NTIS, PC A07/MF A01; 1; GPO Dep. Order Number DE84010341.

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This report represents the third in a series prepared for the New Mexico Public Service Commission (PSC) on issues related to the commercialization and use of dispersed, residential solar energy systems. The principal focus of these reports is the interface between solar energy systems and electric utilities. The focus of this third report is on analyzing electric rate designs for residential customers who use electricity as a back-up source of energy for solar space heating and water heating systems. The overall objective is to provide the PSC with an approach for analyzing solar rate design issues and to develop New Mexico-specific information on the utility and customer impacts of alternative rate design proposals. Principal purposes are: (1) to establish a general framework which outlines the steps in designing and evaluating solar rates; (2) to develop and describe specific methodologies and approaches for addressing issues such as estimating costs-of-service for solar and non-solar customers, rate discrimination, customer cost-effectiveness, and the impacts of solar auxiliary loads on utility operations, costs and finances; (3) to illustrate the use of the methodologies through application with New Mexico-specific data; (4) to provide benchmark information for evaluating solar rate design studies and proposals submitted by New Mexico utilities or other organizations; and (5) to provide the PSC with specific recommendations on procedures and policies related to solar rate design.

1404 Environmental, Legal, And Institutional Aspects

REFER ALSO TO CITATION(S) 28559

28063 **(DOE/CA/10024—T1) Shandiin Institute intertribal solar training program.** (Shandiin Inst., Winslow, AZ (USA)). 1984. Contract FG01-81CA10024. 387p. NTIS, PC A17/MF A01; 1; GPO Dep. Order Number DE84001204.

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This solar training program includes sections on the following: solar orientation; training methodology; photovoltaics; solar cell operation; energy conservation; conservation training methodology; solar water heaters; and solar space heating.

28064 **(DOE/CA/10024—T2) Shandiin/DOE intertribal energy programs: technology transfer series.** (Shandiin Inst., Winslow, AZ (USA)). 1984. Contract FG01-81CA10024. 340p. NTIS MF A01; 2; GPO Dep. Order Number DE84000250.

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This project entailed the continuation of solar design and construction workshops for the Navajo, Hopi, and Apache Tribes, including tribal planners, tribal staff, engineers, architects, and installers of energy systems. The project also entailed the continuation of support for the development of an energy self-sufficient community school system for the many rural Navajo communities. Great emphasis was placed in completing the second phase of development of the intertribal computer network. The development of this network will greatly benefit our nation in increased efficiency and coordination of tribal energy programs. A series of workshops was held in energy programs training for planners from the Navajo, Hopi, and Apache Tribes. The initial assessment of this program concludes that the greatest impact and return came from the Navajo Tribe's Division of Economic Development, with lesser impact upon the Community Development branches of the Hopi and Apache Tribes. The impact of microcomputer technologies upon the tribes has been shown to be profound, and the development of the intertribal computer network can be seen as a true asset to both the tribes and to the nation.

28065 **(WAOENG—82-36) Solar access ordinances in the northwest.** King, S.; Orser, P. (Washington State Energy Office, Olympia (USA)). Dec 1982. Contract FG06-79R000003. 24p. (WS-LGTA—82-05). NTIS, PC A02/MF A01; GPO Dep. Order Number DE84010478.

This booklet identifies a number of ways to protect and provide solar access in new and developed residential areas, ranging from simple zoning amendments to comprehensive solar ordinances. Examples of ordinances which have been adopted in Washington and Oregon are featured throughout the text. A summary is included at the end of the booklet which suggests the order in which the various solar access techniques might be implemented.

1405 Solar Energy Conversion

REFER ALSO TO CITATION(S) 28011, 28012, 28032, 28034, 28035, 28036, 28037, 28044, 28045, 28046, 28047, 28048, 28049, 28050, 28051, 28094, 28182, 28560, 28959, 29300, 29326, 29340, 29400

28066 **(BMFT-FB-T—83-298) Technical use of solar energy. Pt. 1.** Arndt, W.; Bauer, G.H.; Berger, H.U.; Bilger, G.; Bloss, W.H.; Hewig, G.H.; Pfisterer, F.; Schock, H.W. (Bundesministerium fuer Forschung und Technologie, Bonn (Germany, F.R.)). Dec 1983. 78p. (In German). NTIS (US Sales Only), PC A05/MF A01. Order Number DE84751227.

Portions are illegible in microfiche products; With 61 refs., 1 tab., 69 figs.

Due to the state-of-the-art and the potentialities of Cusub(2-x)S-CdS thin film solar cells several companies have installed production lines for this type of solar cells. The R and D programme of project 03E-4045-B was adjusted to this fact. Besides investigations for further enhancing efficiency and long-term stability, for gaining data of physical and electronical parameters, and for improving the theoretical knowledge of the cell, materials and technologies have been investigated looking promising for large-scale industrial production. Cells with an area of 42 cm^2 have been realized showing efficiencies of up to 8%; outdoor tests have revealed that no system-inherent degradation mechanism exists when properly encapsulated cells are tested under realistic operation conditions. Large-area thin films of amorphous silicon with definite and reproducible properties have been produced with two methods, which are well suited for the preparation: RF-sputtering in Ar/H_2-mixtures and glow discharge in SiH_4. Correlations between results of plasma diagnostics and analyses of the layers have been revealed allowing definite variations and an optimization of the production parameters. Various methods for the injection of different types of dopants into the plasma have been proven to result in the implantation of electronically active dopants into the layers.

28067 **(BMFT-FB-T—83-299) Technical applications of solar energy. Project photovoltaic systems and project selective coatings.** Gindele, K.; Honstetter, K.; Karl, H.; Koehl, M.; Lehner, G.; Mast, M.; Spohn, C.; Wagner, A. (Bundesministerium fuer Forschung und Technologie, Bonn (Germany, F.R.)). Dec 1983. 90p. (In German). NTIS (US Sales Only), PC A05/MF A01. Order Number DE84751228.

Portions are illegible in microfiche products; With 33 refs., 5 tabs., 69 figs.

The following report contains mainly two chapters, one on photovoltaic systems and one on selective coatings. The chapter on photovoltaic systems describes: experimental investigations of the long-time-stability of photovoltaic generators; experimental and theoretical investigations of hybrid collectors; experimental and theoretical investigations of concentrating photovoltaic generators; development of devices for measuring the characteristics of solar cells and solar-cell-generators. The chapter on selective coatings is devoted to: the measurement of the radiative properties of selective coatings; the investigations of composition and structure of selective surfaces; the preparation of selective coatings by vapor deposition methods (e.g. cermet-coatings) and by chemical methods (e.g. copper-oxide).

28068 **(CONF-830508—29) Mechanisms limiting performance in polycrystalline silicon solar cells.** Wohlgemuth, J.H.; Culik, J.S.; Alexander, P. (Solarex Corp., Rockville, MD (USA); Jet Propulsion Lab., Pasadena, CA (USA)). May 1983. Contract NAS-7-100-955902. 11p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE84011687.

From 163. Electrochemical Society meeting; San Francisco, CA, USA (8 May 1983).

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Performance-limiting mechanisms in polycrystalline silicon were investigated by fabricating a matrix of $4cm^2$ solar cells of various thicknesses from 10cm x 10cm polycrystalline silicon wafers of several bulk resistivities. The analysis of the results of this matrix indicates that bulk recombination is the dominant factor limiting the short-circuit current in large-grain (greater than 1 to 2 mm in diameter) polycrystalline silicon, the same mechanism that limits the short-circuit current in single-crystal silicon. The average open-circuit voltage of the polycrystalline cells is 30 to 70 mV lower than that of the single-crystal (control) cells; the fill-factor is comparable. Both open-circuit voltage and fill-factor have substantial scatter which is not related to thickness or resistivity. This implies that these parameters are sensitive to an additional mechanism which is probably spatial in nature since the cell position on the wafer was not controlled.

28069 **(CONF-831028—5) Mechanisms limiting the performance of large grain polycrystalline silicon solar cells.** Culik, J.S.; Alexander, P.; Dumas, K.A.; Wohlgemuth, J.W. (Solarex Corp., Rockville, MD (USA); Jet Propulsion Lab., Pasadena, CA (USA); Cabot Corp., Billerica, MA (USA)). Oct 1983. Contract NAS-7-100-955902. 5p. NTIS, PC A02/MF A01; GPO Dep. Order Number DE84011688.

From Photovoltaic solar energy conference; Athens, Greece (17 Oct 1983).

The open-circuit voltage and short-circuit current of large-grain (1 to 10 mm grain diameter) polycrystalline silicon solar cells is determined by the minority-carrier diffusion length within the bulk of the grains. This was demonstrated by irradiating polycrystalline and single-crystal (Czochralski) silicon solar cells with 1 MeV electrons to reduce their bulk lifetime. The variation of short-circuit current with minority-carrier diffusion length for the polycrystalline solar cells is identical to that of the single-crystal solar cells. The open-circuit voltage versus short-circuit current characteristic of the polycrystalline solar cells for reduced diffusion lengths is also identical to that of the single-crystal solar cell. The open-circuit voltage of the polycrystalline solar cells is a strong function of quasi-neutral (bulk) recombination, and is reduced only slightly, of at all, by grain-boundary recombination.

28070 **(DOE/ER/10369—T2) Photoelectrochemistry at iron oxide electrodes. Final technical report.** Kennedy, J.H. (California Univ., Santa Barbara (USA)). 1984. Contract AT03-76ER10369. 5p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE84011453.

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The object of the research program was to extend the knowledge of semiconductor photoelectrochemistry for the decomposition of water into hydrogen fuel and oxygen. In particular, a study of iron oxide electrodes in various electrolytes was investigated.

28071 **(DOE/ET/20599—T1) Evaluation and genetic improvement of black cottonwood for short-rotation coppice culture. Annual technical report.** Stettler, R.F.; Heilman, P.E. (Washington Univ., Seattle (USA). Coll. of Forest Resources; Washington State Univ., Pullman (USA)). 1 Mar 1982. Contract FG01-78ET20599. 32p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE84012458.

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This project addresses two major objectives: (1) genetic improvement and (2) evaluation of quality criteria for fuel and/or chemical use of black cottonwood and its hybrids with P. deltoides. A six-year research program is designed to identify superior clones derived from natural populations of black cottonwood and from hybrids produced with P. deltoides plus trees. Both clonal and seedling selection are used to evaluate performance. Field trials will be conducted on two contrasting but common soil types and will compare early productivity of pure cottonwood plantations and of 1:1 mixtures of cottonwood with red alder (Alnus rubra). From an initial number of 1800 clones to be tested, a selection of the best 360 will be included in a second set of plantations to provide a more realistic assessment of the production potential of the species. A clone bank, preserving all 360 to 500 clones, will serve as a repository of germ plasm for subsequent field trials and research in the region. To satisfy the second major objective, an 8-year-old spacing trial of black cottonwood has been harvested during the first year and analyzed relative to biomass and several wood properties pertinent to fuel production. The progress made during the first four years demonstrates the importance of genetic variation in black cottonwood productivity. 12 references, 5 figures, 11 tables.

28072 **(DOE/JPL/956615—84/2) Laser-assisted solar cell metallization processing. Quarterly report, December 13, 1983-March 12, 1984.** Dutta, S. (Jet Propulsion Lab., Pasadena, CA (USA)). 3 Apr 1984. Contract NAS-7-100-956615. 29p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE84011003.

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The aim of this contract is to investigate, develop, and characterize laser-assisted processing techniques utilized to produce the

fine-line, thin-metal grid structures that are required to fabricate high-efficiency solar cells. During the first quarter of this contract, a comprehensive literature search was carried out in the various state-of-the-art laser-assisted techniques for metal deposition, including laser chemical vapor deposition and laser photolysis of organometallics, as well as laser-enhanced electroplating. A compact system for the experiments involving laser-assisted photolysis of gas-phase compounds was designed and constructed. The work performed in the second quarter is detailed in this report. Metal deposition experiments have been carried out utilizing laser-assisted pyrolysis of a variety of metal-bearing polymer films and metallo-organic inks spun onto silicon substrates. Laser decomposition of spun-on silver neodecanoate ink obtained from Purdue University has yielded very promising results. Solar cell comb metallization patterns have been written using this technique, each pattern being written in a fraction of a second.

28073 **(DOE/R7/01210—T1) Development and testing of corn cob gasifer. Final report.** Haug, R. (Odin Associates, Cambridge, IA (USA)). Oct 1982. Contract FG47-81R701210. 40p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE84009764.

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The purpose of this Appropriate Technology proposal was to test various designs and materials to allow commercialization of gasification equipment for large scale diesel electric generation (generators with rated capacities at or near 1 MW) as well as for small scale cogeneration and other agricultural and industrial applications. At the completion of the project an efficient, low cost, low maintenance, downdraft air gasifier, capable of producing low energy gas (LEG) from gasification of corn cobs was to have been developed and tested. Two such gasifiers were developed and tested along with a wide range of systems and materials for conditioning and delivering the gas to an engine. Standard, off-the-shelf materials were utilized wherever practicable and efficiency of operation was measured in terms of simplicity of design for both operation and maintenance. The final design configuration (and the development of larger scale components designed on the basis of our observations and test results) meets any reasonable criteria for low cost and efficiency.

28074 **(LBL—17684) Formation and degradation of Cu/sub 2-x/S/CdS single-crystal heterojunctions: a high-resolution transmission electron microscope study.** Sands, T.D. (Lawrence Berkeley Lab., CA (USA)). Apr 1984. Contract AC03-76SF00098. 204p. NTIS, PC A10/MF A01; GPO Dep. Order Number DE84011916.

Thesis.

In this study electron-optical methods are applied to the structural characterization of single-crystal Cu/sub 2-x/S/CdS heterojunctions prepared by the aqueous ion-exchange process. Results obtained by scanning electron microscopy, transmission electron microscopy and diffraction, and cross-sectional high-resolution transmission electron microscopy (XHRTEM) are combined to develop a detailed description of the structural evolution of the Cu/sub 2-x/S/CdS heterojunction. The XHRTEM images reveal the two-phase nature of the Cu_2S absorber. The tetragonal phase, a high-pressure polymorph of low chalcocite (Cu_2S), is found to form the metallurgical junction with CdS if the local surface orientation is nearly basal. However, only low chalcocite is detected in the absorber layer if the surface is steeply inclined to the basal plane. these results are rationalized on the basis of lattice misfit, structural compatibility, and the nucleation of h.c.p.-to-f.c.c. transformation dislocations. Lattice misfit considerations are also found to be useful in explaining the morphology of degraded heterojunctions. In particular, the observed shape and orientation of djurleite ($Cu_{1.97}S$) domains in low chalcocite are consistent with the minimization of lattice mismatch. The implications of these results for the reproducible fabrication of high efficiency Cu/sub 2-x/S/CdS solar cells are discussed.

28075 (ORNL—6009, pp 68-82) **Biomass production programs.** Apr 1984. NTIS, PC A09/MF A01. Order Number DE84010672. TI84010672

In Environmental Sciences Division annual progress report for period ending September 30, 1983.

Areas of activity include biofuels program planning (which includes biomass conversion technologies), herbaceous biomass production, woody biomass production under intensive culture, and site productivity concerns related to intensive forest management activities. ESD manages three research programs for the Biomass Energy Technology (BET) Division of the US Department of Energy (DOE): the Herbaceous Energy Crops (HEC) program; the Short-Rotation Woody Crops (SRWC) program; and the Environment and Analysis (EA) program. These research efforts include nutrient studies of intensive forest management, economic analyses of biomass production, and recently initiated resource evaluations for various biomass production strategies for the United States.

28076 **(PB—84-157981) California forest industry: wood consumption and characteristics, 1972. Forest service resource bulletin.** Howard, J.O. (Forest Service, Portland, OR (USA). Pacific Northwest Forest and Range Experiment Station). 1974. 98p. NTIS, PC A05/MF A01.

This report presents the findings of a 100-percent canvass of the primary forest products industry of the State of California, 1972. Tabular presentation includes characteristics of the industry, log consumption statistics, and disposition of mill residues. Accompanying the tables is a description analysis of current conditions and past trends in the industry.

28077 **(SAND—83-2028C) Unique material challenges in photovoltaic concentrator modules.** Beavis, L.C. (Sandia National Labs., Albuquerque, NM (USA)). 1984. Contract AC04-76DP00789. 7p. (CONF-840561—12). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE84010846.

From 17. IEEE photovoltaic specialists conference; Kissimmee, FL, USA (1 May 1984).

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Photovoltaic concentrators operate in a unique environment of high light flux, high temperatures, and large variations in temperature and humidity. The stability of various polymethyl/methacrylate (PMMA) lens formulations to solar environmental exposure has been determined to be variable. The PMMA seems to be unaffected mechanically by the loss or absence of screening agents. Cells exposed to the moist environments become coated with interconnect corrosion products. A clear Dow Corning encapsulant has proven to be durable and capable of protecting cells in this environment. Solder bonds degrade due to temperature cycling and tin diffusion into copper. Finally, a new means of making an electrically insulated low thermal resistance path between the photovoltaic cell and heatsink is described.

28078 **(SAND—83-2032C) Photovoltaic concentrator array reliability.** Maish, A.B.; Chiang, C.J. (Sandia National Labs., Albuquerque, NM (USA)). May 1984. Contract AC04-76DP00789. 8p. (CONF-840561—4). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE84010973.

From 17. IEEE photovoltaic specialists conference; Kissimmee, FL, USA (1 May 1984).

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This paper summarizes array reliability and analyzes start-up and operational experiences on five first-generation Fresnel-lens PV concentrator array installations which have been operational for periods ranging from 1 to 4-1/2 years. Although some start-up problems have been encountered, concentrator array availability is high, about 97%. Field NOC efficiencies are between 10.5 and 11%. Performance degradation of field output is low, about 1 to 2% a year, and is due mostly to component failures not component degradation. Results of full field module performance surveys are given. The majority of failures found in the field are due to poor manufacturing control and the balance are due to design problems which have been corrected in second generation arrays.

28079 **(SAND—84-0111C) Superlattice structures grown by molecular beam epitaxy.** Dawson, L.R. (Sandia National Labs., Albuquerque, NM (USA)). 1984. Contract AC04-76DP00789. 25p. (CONF-840570—2). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE84011288.

From Materials for future energy systems conference; Washington, DC, USA (1 May 1984).

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Recent advances in the preparation of superlattice structures have made it possible to tailor the optical, electrical and metallurgical properties of semiconductors in ways that could strongly impact the performance of advanced concept, multijunction photovoltaic devices. The interfacial strain in lattice-mismatched superlattices (strained-layer superlattices) offers a method of eliminating the large numbers of misfit defects usually present in the mismatched bulk alloy semiconductors needed for optimum high performance cells. Extensive characterization of such structures indicates excellent optical, electrical, and metallurgical quality in spite of the large number of strained interfaces. Junction photodetectors fabricated from such materials show peak internal quantum efficiency in excess of 70%.

28080 **(SAND—84-0968C) Comparison of concentrating collectors to tracking flat panels.** Jones, G.J. (Sandia National Labs., Albuquerque, NM (USA)). 1984. Contract AC04-76DP00789. 20p. (CONF-840441—1). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE84010977.

From 17. photovoltaic specialist conference; Orlando, FL, USA (30 Apr 1984).

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Two-axis tracking appears to be the economic optimum for photovoltaic flat-panel technology. This requires a new comparison of flat-panel and concentrator arrays using the most competitive flat-panel option. The array field costs for a two-axis tracking flat-panel should be nearly identical to the costs for a concentrator. Therefore, module costs for the two technologies can be compared directly, simplifying the analysis. For example, at southwestern sites, characterized by a high direct-to-diffuse insolation ratio, 12% flat-panels are found to be equivalent to 15% concentrators of the same cost ($/m²). For regions with more diffuse radiation the concentrator must be over 18% efficient to be equivalent.

28081 **(SAND—84-1000C) Emitter recombination and minority carrier lifetime measurements on high efficiency Si solar cells.** Rose, B.H.; Weaver, H.T. (Sandia National Labs., Albuquerque, NM (USA)). 1984. Contract AC04-76DP00789. 6p. (CONF-840561—11). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE84011255.

From 17. IEEE photovoltaic specialists conference; Kissimmee, FL, USA (1 May 1984).

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A new method has been used to extract the emitter saturation current density directly from transient decay times of short circuit current and open circuit voltage in high efficiency Si solar cells. The method requires measurement of V/sub oc/, J/sub sc/ and their respective asymptotic decay times. The technique is also used to account for unusually high V/sub oc/ values of recent conventional Si solar cells, and to demonstrate the presence of bandgap narrowing in the heavily doped emitter.

28082 **(SERI/STR—231-2206) Research, development, and demonstration of algal production raceway (APR) systems for the production of hydrocarbon resources.** Laws, E.A. (Hawaii Univ., Honolulu (USA). Dept. of Oceanography). Feb 1984. Contract AC02-83CH10093. 58p. NTIS, PC A04/MF A01; GPO Dep. Order Number DE84004486.

A fractional factorial experimental design was used to determine the maximum production and photosynthetic efficiency that could be achieved in shallow algal mass culture systems (SAMCS) of the marine diatom Phaeodactylum tricornutum. Dilution rate and CO_2 supply were found to be the most important system parameters. Maximum production was found to be about 25 g dry wt $m^{-2}d^{-1}$. This production corresponded to a photosynthetic efficiency of 5.6%. These figures are 50 to 100% better than the production rates achieved in earlier P. tricornutum cultures using conventional culture techniques. The results are consistent with a theoretical model of the impact of the flashing light effect on algal mass culture production. This model predicts that at the typical irradiances in Hawaii, full utilization of the flashing light effect should enhance production by 70% to over 200%. It was concluded that the use of foil arrays in the experimental flume creates systematic vertical mixing on a time scale suitable for utilizing the flashing light effect. Production of P. tricornutum culture is probably limited by temperature. P. tricornutum cannot survive at temperatures in excess of 25°C in outdoor mass cultures. Growth of mesophilic species in the temperature range 30 to 35°C may well result in even higher production than that achieved with P. tricornutum.

28083 **(SERI/STR—231-2207) Screening for lipid yielding microalgae: activities for 1983. Final subcontract report.** (Solar Energy Research Inst., Golden, CO (USA)). Apr 1984. Contract AC02-83CH10093. 54p. NTIS, PC A04/MF A01; 1; GPO Dep. Order Number DE84004500.

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The SERI/DOE Aquatic Species Program is conducting a screening project, to select microalgae species and strains that are acceptable for liquid fuel production in outdoor culture. The emphases are on finding species that grow rapidly at high biomass density, in outdoor culture and produce large quantities of lipids. During 1983 over 100 species were isolated from saline waters at the California and Nevada deserts. Some of these species were characterized for growth response to various nutrients, temperatures, and salinities. Selected species were analyzed for lipid composition. Lipids were characterized into fractions, hydrocarbons, isoprenoids, triglyceride, glycolipids, and phospholipids. The most promising species were tested for growth and monoculture sustainability in outdoor culture. Each section (microalgae selection, chemical profiles of microalgae, mass culture of macroalgae) was abstracted separately. 51 references, 8 figures, 14 tables.

28084 (SERI/STR—231-2207, pp 1-15) **Selection of oil-producing desert microalgae.** Thomas, W.H. (Scripps Institution of Oceanography, San Diego, CA). Apr 1984. NTIS, PC A04/MF A01. Order Number DE84004500. TI84004500

In Screening for lipid yielding microalgae: activities for 1983. Final subcontract report.

The purpose of these studies are to progressively select desert saline algae in which yields of cell material and their oil content can be maximized. The studies progress from field work to laboratory work and eventually to outdoor culture work in a logical fashion. This work has been separated into five tasks: sampling desert saline waters; isolation and culturing algae from these waters; chemical analyses of these waters; preliminary selection experiments; and maximizing algal yields in the laboratory. 5 figures, 5 tables.

28085 (SERI/STR—231-2207, pp 16-38) **Chemical profiles of microalgae with emphasis on lipids.** Tornabene, T.G.; Ben-Amotz, A.; Raziuddin, S.; Hubbard, J. (Georgia Inst. of Tech., Atlanta). Apr 1984. NTIS, PC A04/MF A01. Order Number DE84004500. TI84004500

In Screening for lipid yielding microalgae: activities for 1983. Final subcontract report.

The proximate chemical composition of seven species of fresh water, desert and marine unicellular eukaryotic microalgae grown under controlled conditions was measured with emphasis on the lipids. Ankistrodesmus, Dunaliella spp., Isochrysis, Nannochloris and Nitzschia contained a range of 16% to 38% proteins, 9% to 56% carbohydrates, and 7% to 55% lipids of organic cell weight. Botryococcus braunii contained about 45% lipids. The effect of cultivations on proximate chemical compositions of Botryococcus braunii, Dunaliella salina and Isochrysis in nitrogen deficiency medium, was a decrease in protein content and an increase in carbohydrate content, in Duneliella Salina a decrease in lipids, and in Isochrysis an increase in lipid content. Cultivation of Dunaliella salina in medium with increased concentration of sodium chloride induced the accumulation of osmotic glycerol with minimal effect on the other constituents. In Botryococcus and Isochrysis the sodium chloride stress was mainly expressed through reduction in the protein content. The lipids of Botryococcus braunii, Isochrysis sp., and nitrogen deficient cultivated Dunaliella bardawil consisted of relatively high concentrations of neutral lipids with multiple branched hydrocarbons predominating. The polar lipid composition of glycolipids and phospholipids of all species investigated was fairly typical of photosynthetic eukaryotic algae in general. The fatty acid compositions were species specific with changes occurring in the relative intensities of individual acid chains of cells cultivated under different cultivation conditions and growth phases. The data presented provides additional evidence to

the concept of biochemical classification and its control by environmental factors. 51 references, 3 figures, 6 tables.

28086 (SERI/STR—231-2207, pp 39-44) **Mass culture of selected microalgae. Outdoor studies on Ankistrodesmus and Scenedesmus SO2.** Weissman, J.; Benemann, J.R. (Microbial Products, Inc., Vacaville, CA; Enbio, Inc., Fairfield, CA). Apr 1984. NTIS, PC A04/MF A01. Order Number DE84004500. TI84004500

In Screening for lipid yielding microalgae: activities for 1983. Final subcontract report.

Two strains, shown by the screening program to be promising lipid producers, were inoculated and maintained outdoors. The Ankistrodesmus, isolated from Pyramid Lake, was cultivated in brackish waters. After initial problems with salt balance in the medium, (too little potassium) it grew well under nitrogen sufficiency and consisted of 27 +- 5% lipid. Nitrogen deficiency studies were initiated late in the growing season, (lipid composition is still being analyzed) but the strain is problematical in that regreening of starved cultures (after reintroduction of nitrogen) is too slow under the high light irradiances occurring outdoors. Regreening in the laboratory was not a problem. This strain was grown in batch only. Optimization of the medium has not been fully achieved. Another promising strain, Scenedesmus SO2a was inoculated into the outdoor system and grown continuously and in batch. It grew well, although the medium may also not yet be optimal. It regreened readily after nitrogen starvation. Lipid content of nitrogen sufficient cultures was 18%. The analysis of lipid content of induced cultures is still being completed. 3 tables.

28087 **Quantum well multijunction photovoltaic cell.** Chaffin, R.J.; Osbourn, G.C. (to Dept. of Energy). US Patent Application 6-512,059. 8 Jul 1983. 19p. Contract AC04-76DP00789.

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A monolithic, quantum well, multilayer photovoltaic cell comprises a p-n junction comprising a p-region on one side and an n-region on the other side, each of which regions comprises a series of at least three semiconductor layers, all p-type in the p-region and all n-type in the n-region; each of said series of layers comprising alternating barrier and quantum well layers, each barrier layer comprising a semiconductor material having a first bandgap and each quantum well layer comprising a semiconductor material having a second bandgap when in bulk thickness which is narrower than said first bandgap, the barrier layers sandwiching each quantum well layer and each quantum well layer being sufficiently thin that the width of its bandgap is between said first and second bandgaps, such that radiation incident on said cell and above an energy determined by the bandgap of the quantum well layers will be absorbed and will produce an electrical potential across said junction.

28088 **Improved photovoltaic cells and electrodes.** Skotheim, T.A. (to Dept. of Energy). US Patent Application 6-509,076. 29 Jun 1983. 8p. Contract AC02-76CH00016.

Improved photovoltaic cells and electrodes for use therein, particularly electrodes employing amorphous silicon or polyacetylene coating are produced by a process which includes filling pinholes or porous openings in the coatings by electrochemical oxidation of selected monomers to deposit insulating polymer in the openings.

28089 **Polycrystalline silicon availability for photovoltaic and semiconductor industries.** Ferber, R.R.; Costogue, E.N.; Pellin, R. (Jet Propulsion Lab., Pasadena, CA). *International Journal of Solar Energy;* **1**: No. 2, 105-124(Oct 1982).

Polycrystalline silicon is an essential material for the production of semiconductor devices and photovoltaic solar cells. The availability of the material at low prices is critical to ensure the existence and growth of the photovoltaic industry. The ever-increasing demand for semiconductor devices, ie, integrated circuit and power devices, resulted in concern for the availability of refined silicon for photovoltaic solar cells. Three surveys were conducted to update the information based on the capacities of polycrystalline silicon refiners and plans for expansion. The paper presents the results of the surveys - summarizing the market forecast for polycrystalline silicon, the free world polycrystalline production capacity forecast, and the status of the new technology processes for the production of low cost polycrystalline silicon. It can be concluded that the aggressive semiconductor devices market, coupled with a potential photovoltaic market, should assure the polycrystalline silicon refining industry a flourishing future.

28090 **Integral assembly of photovoltaic arrays using glass.** Younger, P.R.; Kirkpatrick, A.R. (Spire Corp., Bedford, MA). *Science of Advanced Materials and Process Engineering Proceedings;* **23**: vp(1978). (CONF-780502—).

From 23. national SAMPE symposium; Anaheim, CA, USA (2 May 1978).

For a number of reasons glass is an excellent material for encapsulation of solar cell arrays. Glass can be readily available at relatively low cost. It exhibits excellent stability against degradation by solar untraviolet illumination and atmospheric pollutants. A superior approach results if glass is employed directly as an integral encapsulant without secondary organic materials. A description is presented of a electrostatic bonding process which is being developed for integral assembly of glass encapsulated arrays. Solar cells are placed in contact with the glass surface, temperature is raised until the glass becomes ionically conductive, and an electric field is applied to initiate the bonding action. Silicon solar cells up to 3 inches in diameter have been integrally bonded without degradation.

28091 **Recent developments in low cost silicon solar cells for terrestrial application.** Leipold, M.H. *Science of Advanced Materials and Process Engineering Proceedings;* **23**: 354-365(1978). (CONF-780502—).

From 23. national SAMPE symposium; Anaheim, CA, USA (2 May 1978).

A variety of techniques may be used for photovoltaic energy systems. Concentrated or not concentrated sunlight may be employed, and a number of materials can be used, including silicon, gallium arsenide, cadmium sulfide, and cadmium telluride. Most of the experience, however, has been obtained with silicon cells employed without sunlight concentration. An industrial base exists at present for producing solar cells at a price in the range from $15 to $30 per peak watt. A major federal program has the objective to reduce the price of power provided by silicon solar systems to approximately $1 per peak watt in the early 1980's and $0.50 per watt by 1986. The approaches considered for achieving this objective are discussed.

1406 Photovoltaic Power Systems

REFER ALSO TO CITATION(S) 28010, 28067

28092 **(DOE/ER/10170—T1) Preliminary working paper: satellite power system and lesser developed countries.** Oliver, T.E.; Ventry, L.T.; DuBois, C.; Dhanda, R. (JWK International Corp., Annandale, VA (USA)). 3 Feb 1980. Contract AC01-80ER10170. 109p. NTIS, PC A06/MF A01; 1; GPO Dep. Order Number DE84011262.

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The objective of this report is to screen selected countries that, by geographical location, might be appropriate sites for the rectenna system and for which technical, environmental, social, demographic, political, and economic factors make a Satellite Power System (SPS) project appear possible. The study focused on countries that are referred to as Lesser Developed Countries (LDCs). Of 130 countries, sovereignties, and dependencies classified by the United Nations as less developed, thirteen countries were selected for study. The countries in the Americas are Mexico, Colombia, Venezuela, and Brazil. On the African continent, the countries are Algeria, Senegal, Gambia, Zaire, and Kenya. The countries in Asia and Oceania are The People's Republic of China, India, Thailand, and Indonesia. Certain general conclusions can be drawn from this study. Countries that might be able to support or contribute to SPS are the established, major energy exporters. The consumption of countries that export some energy virtually matches production. They may be able to pay for SPS in the years 2000 or 2025, but increased economic development and diversification of exports will need to be implemented first. Finally, those countries that import

energy do not have an economic base by which they could support SPS unaided, but require energy. All thirteen nations could benefit from SPS. SPS could prove invaluable to these countries with sensitive economies. The added electrical energy could bolster their economies and provide for increased development so that the nations could suppport or contribute to SPS.

28093 **(NASA/CR—3344) Electrostatic protection of the Solar Power Satellite and rectenna. Part I. Protection of the Solar Power Satellite.** (Rice Univ., Houston, TX (USA)). Nov 1980. Contract AI01-79ER10035. 35p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE84012299.

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This report examines theoretically several features of the interactions of the Solar Power Satellite (SPS) with its space environment. We calculate the voltages produced at various surfaces due to space plasmas and the plasma leakage currents through the kapton and sapphire solar cell blankets. At geosynchronous orbit (GEO), this parasitic power loss is only 0.7%, and is easily compensated by oversizing. At low-earth orbit, (LEO), the power loss is potentially much larger (3%), and anomalous arcing is expected for the EOTV high voltage negative surfaces. Preliminary results of a three-dimensional self-consistent plasma and electric field computer program are presented, confirming the validity of the predictions made from the one-dimensional models. Lastly, the report considers magnetic shielding of the satellite, to reduce the power drain and to protect the solar cells from energetic electron and plasma ion bombardment. It is concluded that minor modifications can allow the SPS to operate safely and efficiently in its space environment. The SPS design employed in this study is the January 25, 1978 MSFC baseline design utilizing GaAs solar cells at CR-2 and an aluminum structure. Subsequent design changes will substantially alter the basic conclusions in this report.

28094 **(SAND—84-0106/2) Review and analysis of key findings of the Fifth Photovoltaic Systems Project Integration Meeting.** Jones, G.J.; Key, T.S.; Post, H.N.; Stevens, J.W.; Thomas, M.G. (Sandia National Labs., Albuquerque, NM (USA)). Apr 1984. Contract AC04-76DP00789. 24p. NTIS, PC A02/MF A01; GPO Dep. Order Number DE84011627.

This document provides a brief newspaper-like discussion of twenty-three of the major results from the 5th Photovoltaic Systems Project Integration Meeting (PIM). The document has been arranged so that it starts with systems research and evaluation results, proceeds then to array field engineering, power conditioning development and ends with utility interface and operations research.

28095 **(SAND—84-0125C) Operational and performance experience of selected small- and intermediate-sized photovoltaic systems.** Burgess, E.L.; Menicucci, D.F. (Sandia National Labs., Albuquerque, NM (USA)). 1984. Contract AC04-76DP00789. 7p. (CONF-840622—4). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE84010974.

From Annual meeting of the American Solar Energy Society; Anaheim, CA, USA (5 Jun 1984).

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Operational and performance experience are summarized for DOE-funded residential and intermediate-sized photovoltaic systems. These systems have operated for up to three years and the lessons learned are being incorporated into new system designs.

28096 **(SAND—84-0874C) Designing future photovoltaic systems.** Jones, G.J. (Sandia National Labs., Albuquerque, NM (USA)). 1984. Contract AC04-76DP00789. 7p. (CONF-840622—2). NTIS, PC A02; 3; GPO Dep. Order Number DE84010597.

From Annual meeting of the American Solar Energy Society; Anaheim, CA, USA (5 Jun 1984).

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The large scale use of photovoltaic systems to generate our electricity is a dream for the future; but if this dream is to be realized, we must understand these systems today. As a result, there has been extensive research into the design and economic tradeoffs of utility interconnected photovoltaic applications. The understanding gained in this process has shown that photovoltaic system design can be a very simple and straight-forward endeavor. This paper reviews those past studies and shows how we have reached the present state of system design evolution. The concept of the utility interactive PV system with energy value determined by the utility's avoided cost will be explored. This concept simplifies the screening of potential applications for economic viability, and we will present several rules-of-thumb for this purpose.

28097 **(SAND—84-0992C) Effect of photovoltaic systems on utility operations.** Thomas, M.G.; Stevens, J.W.; Jones, G.J.; Anderson, P.L. (Sandia National Labs., Albuquerque, NM (USA); Arizona State Univ., Tempe (USA)). 1984. Contract AC04-76DP00789. 6p. (CONF-840561—10). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE84011484.

From 17. IEEE photovoltaic specialists conference; Kissimmee, FL, USA (1 May 1984).

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The introduction of photovoltaic generation into the grid can potentially affect the utility's power control system. A computer simulation has been used to study the effects of large photovoltaic system operation on utility automatic generation control. Potential problem areas are identified and mitigating operational strategies are proposed.

1407 Solar Thermal Power Systems

REFER ALSO TO CITATION(S) 28092, 28181, 28187, 28190

28098 **(ATR—78(7695-02)-1) Dynamic simulation model of the Solar Thermal Test Facility (STTF): preliminary description.** (Aerospace Corp., El Segundo, CA (USA). Energy Systems Group). 15 Mar 1978. Contract AT03-76CS51101. 56p. (STMPO—019). NTIS, PC A04/MF A01; 1; GPO Dep. Order Number DE84008926.

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This report presents a description of a computer program for the simulation of the Solar Thermal Test Facility (STTF) and an experiment run at that facility. The STTF is a general-purpose solar test facility with subsystems designed to provide solar thermal energy to a variety of experiments. The basic facility consists of (a) a relocatable heliostat field, (b) a tower for mounting experiments, water and electrical resources, (c) a cooling tower, (d) a computerized control system, (e) a data acquisition system, and (f) provisions for experiments. The simulation program structure contains equivalent computer modules for each of the STTF subsystems and experiments which permit rapid simulation of the experiments or new facility configurations under differing environmental and test conditions. The program is written with a modular structure to allow the experimenter to easily incorporate a new experiment or to modify or add to the facility configuration itself. The programming is done in standard FORTRAN IV and the program size is compatible with all commonly used technical computer systems. The report describes the detailed STTF plant dynamic model, the program structure, and the verification of the model by comparison of the computer results with facility and experiment data. Finally, a list of program applications is described.

28099 **(CONF-840570—3) Ocean thermal energy conversion - materials issues.** Darby, J.B. Jr. (Argonne National Lab., IL (USA)). 1984. Contract W-31-109-ENG-38. 10p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE84012094.

From Materials for future energy systems conference; Washington, DC, USA (1 May 1984).

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The Ocean Thermal Energy Conversion (OTEC) Program, in the Ocean Energy Technology Division of the U.S. Department of Energy, is concerned with the development of options that can be utilized to extract and distribute significant amounts of energy from the ocean. The biofouling control and materials portion of the program is concerned with the development of effective and environmentally acceptable methods to minimize biofouling and corrosion in high thermal conductivity materials suitable for use in heat exchangers and condensers. The mechanical and chemical tech-

niques employed for biofouling control are reviewed and the recent success with chlorination is presented. The corrosion of aluminum alloys, copper alloys, stainless steel, stainless alloys, and titanium in near-surface warm and deep cold water is reviewed with emphasis on aluminum alloys. The major materials issues are reviewed with emphasis on lifetime and cost.

28100 **(DOE/CE—0069) Build your own solar air heater.** (Conservation and Renewable Energy Inquiry and Referral Service, Silver Spring, MD (USA)). Jan 1984. 7p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE84011566.

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This information brochure gives construction procedure, installation instructions and a materials list for building a solar air heater.

28101 **(DOE/CH/00178—T20-Vol.1) Selected bibliography of solar thermal literature. Volume 1: bibliography.** (Solar Energy Research Inst., Golden, CO (USA)). 1984. Contract AC02-77CH00178. 771p. NTIS, PC A99/MF A01; 1; GPO Dep. Order Number DE84011386.

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The document collection represented in this publication is housed in, and available to the solar thermal community from, the Solar Energy Information Center - a component of the Solar Energy Information Data Bank (SEIDB) - at the Solar Energy Research Institute in Golden, Colorado. The information provided by this publication is divided into two volumes. Volume 1 constitutes the major portion of the publication. This is the volume to which the four sections in Volume 2 refer. It is composed of bibliographic records, each of which contains basic information such as author, title, date, number of pages and so on. The bibliographic records are listed by unique record number (BIBLIO ID NUMBER) in groups by year. Records without dates appear at the beginning of the section under the year 19 .

28102 **(DOE/CH/00178—T20-Vol.2) Selected bibliography of solar thermal literature. Volume 2: indexes.** (Solar Energy Research Inst., Golden, CO (USA)). 1984. Contract AC02-77CH00178. 415p. NTIS, PC A18/MF A01; 1; GPO Dep. Order Number DE84009363.

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The document collection represented in this publication is housed in, and available to the solar thermal community from, the Solar Energy Information Center - a component of the Solar Energy Information Data Bank (SEIDB) - at the Solar Energy Research Institute in Golden, Colorado. The information provided by this publication is divided into two volumes. Volume 2 is composed of four sections in the following order: (1) subject index; (2) key words from titles index; (3) author index; and (4) report number index.

28103 **(DOE/CS/51101—4) Dynamic computer simulation of the DOE 10 MW Solar Thermal Pilot Plant.** Zondervan, K.L.; Steffan, K.F.; Connor, T.J. (Aerospace Corp., El Segundo, CA (USA)). Nov 1978. Contract AT03-76CS51101. 11p. (CONF-781133—6; STMPO—028). American Institute of Aeronautics and Astronautics, 1290 Avenue of the Americas, New York, NY 10019. Order Number DE84010531.

From AIAA conference on solar energy; Phoenix, AZ, USA (27 Nov 1978).

An approach to modeling for digital computer simulation of the five subsystems comprising the DOE's 10 MW Solar Thermal Pilot Plant to be located at Barstow, California, is discussed. Also presented are initial results of a simulation of the plant performance in response to the rapid passage of an ideal, short duration cloud directly over the site. Results indicate that the fundamental time constants of the Receiver (solar boiler), and likely controller response of that subsystem, will result in tightly controlled steam conditions.

28104 **(DOE/DR/00789—T1) 1984 Program of work: test and evaluation of CRS and DCS plants.** Martin, J.G.; Wattiez, P.; Munox, F.R. (Sandia National Labs., Livermore, CA (USA); Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt e.V., Koeln (Germany, F.R.)). Mar 1984. Contract AC04-76DR00789. 55p. NTIS, PC A04/MF A01; 1; GPO Dep. Order Number DE84012477.

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The predominant objective for the Program of Work (POW) - 1984 is to collect and evaluate performance and loss data, and to evaluate proposed improvements (Optimization) to support completion of the committed deliverables; those being the reports of the Central Receiver System (CRS) and the distributed collector system (DCS).

28105 **(DOE/DR/00789—T2) Plant operation report and daily operation summary. Monthly data.** (Sandia National Labs., Livermore, CA (USA); Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt e.V., Koeln (Germany, F.R.)). 26 Apr 1984. Contract AC04-76DR00789. 75p. NTIS, PC A04/MF A01; 1; GPO Dep. Order Number DE84012479.

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This report summarizes the operational, maintenance and evaluation activities and highlights that were required during the month of February 1984 for the Central Receiver System and the Distributed Collector System.

28106 **(DOE/DR/00789—T3) Plant operation report and daily operation summary. Monthly data.** (Sandia National Labs., Livermore, CA (USA); Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt e.V., Koeln (Germany, F.R.)). 1984. Contract AC04-76DR00789. 79p. NTIS MF A01; 2; GPO Dep. Order Number DE84012478.

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This report summarizes the opertional, maintenance and evaluation activities and highlights that were required during the month of January 1984 for the Central Receiver System and the Distributed Collector System.

28107 **(DOE/ET/21007—1) 10 MWe solar thermal central receiver pilot plant: conceptual design review package.** Frohardt, M. (Martin Marietta Aerospace, Denver, CO (USA)). 16 Oct 1978. Contract AC03-79ET21007. 103p. (STMPO—283; MCR—78-1323). NTIS, PC A06/MF A01; 1; GPO Dep. Order Number DE84011217.

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This conceptual design review package includes the following: system parameters, heliostat structures and mechanisms; 10 MWe mirror assembly; NASTRAN computer analysis; heliostat pointing and alignment; analysis; electronics; P/W board design; electrical power and distribution system; and software.

28108 **(DOE/ET/21007—2) 10 MWe solar thermal central receiver pilot plant. Preliminary design review package.** Frohardt, M. (Martin Marietta Aerospace, Denver, CO (USA)). 28 Nov 1978. Contract AC03-79ET21007. 111p. (STMPO—284; MCR—78-1330). NTIS, PC A06/MF A01; 1; GPO Dep. Order Number DE84011218.

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This preliminary design review package includes: structures and mechanics; mirror assembly; heliostat pointing and alignment; heliostat coordinate definitions; field electrical power; control system requirements; HAC configuration; HC/HFC packaging; electrical cabling; phase I test program; manufacturing and tooling; and systems.

28109 **(DOE/ET/21007—3) 10 MW/sub e/ Solar Thermal Central Receiver Pilot Plant. Final design review package.** Frohardt, M. (Martin Marietta Aerospace, Denver, CO (USA)). 05 Feb 1979. Contract AC03-79ET21007. 174p. (STMPO—285; MCR—79-1302). NTIS, PC A08/MF A01; 1; GPO Dep. Order Number DE84011219.

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The final design review package includes: systems; life cycle costs; structures and mechanics; structural design; mirror assembly; heliostat pointing and alignment; error allocations; control system software and hardware; maintenance and reliability; phase I test program; manufacturing and tooling; and drawing attachment.

28110 **(DOE/ET/21007—4) 10 MW/sub e/ solar thermal central receiver pilot plant: Phase II operating and maintenance equipment.** (Martin Marietta Aerospace, Denver, CO (USA)). Aug 1979. Contract AC03-79ET21007. 17p. (STMPO—286). NTIS, PC A02/MF A01; GPO Dep. Order Number DE84011220.

This document defines the installation, operating and maintenance equipment required for the pilot plant. Its purpose is for the definition and provisioning of operation and maintenance equipment that will support pilot plant field operations, scheduled maintenance operations, unscheduled maintenance and maintenance repairs.

28111 **(DOE/SF/10539—01) Quality assurance plan for 10 MWe Phase II.** (Martin Marietta Corp., Denver, CO (USA). Denver Div.). Oct 1980. Contract AC03-80SF10539. 11p. (STMPO—288; MCR—79-1352B). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE84011448.

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This document describes the system for implementing the, Collector Subsystem for the 10 MWe Solar Thermal Central Receiver Pilot Plant, Quality Assurance Program. The 10 MWe Phase II Quality Assurance Plan (QA Plan) establishes the requirements and controls that will be implemented during procurement, fabrication, assembly, installation checkout, and acceptance of 10 MWe Phase II hardware and software.

28112 **(DOE/SF/10539—02) 10 MW/sub e/ solar pilot plant collector subsystem: system safety plan.** Briggs, R.W. (Martin Marietta Corp., Denver, CO (USA). Denver Div.). Feb 1980. Contract AC03-80SF10539. 16p. (STMPO—289; MCR—80-1304). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE84011436.

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This plan describes the System Safety Engineering effort to be accomplished during Phase II of the 10 MW/sub e/ Solar Central Receiver Pilot Plant Collector Subsystem. This plan covers system safety engineering as applied to design, fabrication, assembly, test, activation, start-up, operation and maintenance of the Collector Subsystem (CS) and to training of CS operator and maintenance personnel. The plan includes interface requirements with other subsystem and the integration of the Collector Subsystem with the 10 MW/sub e/ Solar Thermal Central Receiver Pilot Plant during activation, start-up and operation. This plan includes the management and technical approach for implementation of DOE SAN 0501-01, Pattern of Health and Safety Responsibilities, to achieve minimum accident risk. The purpose of this plan is to eliminate or control to acceptable limits those hazards inherent in the Collector Subsystem which could cause injury to personnel or damage to facilities and equipment.

28113 **(DOE/SF/10539—03) Hazard analysis for 10 MW/sub e/ solar thermal central receiver pilot plant, preliminary report.** Briggs, R.W. (Martin Marietta Corp., Denver, CO (USA). Denver Div.). 4 Mar 1980. Contract AC03-80SF10539. 33p. (STMPO—290; MCR—78-1331B). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE84011447.

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The attached Hazard Analysis consists of a systematic hazard identification and qualitative analysis of the collector subsystem and components in all operational modes and anticipated natural environments. The analysis identified design criteria and operational constraints to eliminate or control accident potentials caused by human error, environment, deficiency/inadequacy of design, or component malfunction. Conditions that are suspect of having accident potential are indicated by a unique number and are documented on the Potential Hazard Matrix. The Hazard Analysis is summarized on the Hazard Catalog, Part I Hazards List, to provide current status of all identified hazards. Finally, the potential Hazard Matrix and the Hazard Catalog each trace through the unique number to the individual Hazard Analysis, a complete assessment of the accident potential of each identified hazard.

28114 **(DOE/SF/10539—04) 10 MWe solar thermal central receiver pilot plant. Phase II Manufacturing Plan, Revision 2.** (Martin Marietta Corp., Denver, CO (USA). Denver Div.). Apr 1980. Contract AC03-80SF10539. 32p. (STMPO—291). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE84011451.

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This Phase II Manufacturing Plan presents the manufacturing and associated procurement operations necessary to implement a successful program. This document has been prepared to provide visibility into the various considerations affecting the manufacturing and procurement processes for Phase II. Definition is given to which components are manufactured versus those which are procured, component availability, process, cost/performance, assembly operations, the detailed manufacturing plan, and areas for further improvement.

28115 **(DOE/SF/10539—05) 10 MWe collector subsystem software/firmware functional requirements specification.** (Martin Marietta Corp., Denver, CO (USA). Denver Div.). 12 Jun 1980. Contract AC03-80SF10539. 109p. (STMPO—292). NTIS, PC A06/MF A01; 1; GPO Dep. Order Number DE84011435.

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This Functional Requirements Specification for the 10 MWe Solar Thermal Power Plant Collector Subsystem software provides: (1) the system functional requirements to be satisfied and shall be the basis for mutual understanding between the customer and the developer; and (2) the basis for development of software/firmware testing during the System Level Test. The software for the 10 MWe Solar Thermal Plant Collector Subsystem (Phase II) shall have the capability to allow operator control of up to 2048 heliostats in the operation of the pilot plant at Barstow, California. This function includes the capability of OCS, BCS, and DAS interface, system redundancy, as well as operator commanded mode control, graphic display, status display, and alarm generation.

28116 **(DOE/SF/10539—06) System description document: collector subsystem for the 10 MWe solar thermal central receiver pilot plant. Phase II.** (Martin Marietta Corp., Denver, CO (USA). Denver Div.). Aug 1980. Contract AC03-80SF10539. 20p. (STMPO—293; MCR—80-1362). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE84011426.

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Each heliostat consists of: (1) the mirror assembly; (2) the mirror support or rack assembly; (3) the drive mechanism; (4) the main support pedestal; (5) the pedestal foundation; and (6) associated instrumentation, controls, and signal cabling; see Figure M2-2. The components are designed to be transported by highway and railroad carriers using standard transport vehicles and materials handling equipment and within applicable federal and state regulations. The heliostats are designed for a 30-year life. Control of the field of heliostats is accomplished by means of a distributed computer control system consisting of a minicomputer located in the plant control room and a network of data buses and microcomputer-based controllers located at the heliostats. The reflective surface on each heliostat is rotated about azimuth and elevation axes by means of a gear-drive unit and electric motors. The actual azimuth and elevation angles are determined by means of incremental optical encoders and a microcomputer, and the microcomputer provides the logic to turn the drive motors on and off as required. The Heliostat Array Controller (HAC) computer system consists of a set of identical, dual-redundant MODCOMP CLASSIC computers, with a set of peripheral and input/output equipment needed to satisfy the HAC computer system requirements.

28117 **(DOE/SF/10539—07) Heliostat Stimulator operator's manual.** (Martin Marietta Corp., Denver, CO (USA). Denver Div.). Nov 1980. Contract AC03-80SF10539. 42p. (STMPO—294; MCR—80-1376). NTIS, PC A03; 3; GPO Dep. Order Number DE84011439.

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The Heliostat Stimulator is a portable test tool, housed in a suitcase, which can be used to perform the following functions: (1) acceptance testing of newly manufactured Heliostat Controllers (HC) and Heliostat Field Controllers (HFC); (2) aid in the installation and alignment of Heliostats; and (3) provide diagnostic troubleshooting capability in the event of Heliostat failure in the field.

28118 **(DOE/SF/10539—09) Maintenance instructions: heliostat field subsystem for 10 megawatt solar power system/central receiver system.** (Martin Marietta Corp., Denver, CO (USA). Denver Div.). Aug 1981. Contract AC03-80SF10539. 70p. (STMPO—296; MCR—81-1709A). NTIS, PC A04/MF A01; 1; GPO Dep. Order Number DE84011449.

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This manual describes the maintenance procedures required to properly maintain the Heliostat Field Subsystem. All required authorized maintenance procedures are described, including normal maintenance, preventative maintenance, and removal and replacement of components. Procedures for those items that are recommended to be returned to the supplier for repair are included. Retest and/or calibration procedures that must be performed after removal and replacement of components or after maintenance on the system are included.

28119 **(DOE/SF/10539—11) Supplemental spares plan: heliostat field subsystem for 10 megawatt solar power systems/central receiver system.** (Martin Marietta Corp., Denver, CO (USA). Denver Div.). Dec 1981. Contract AC03-80SF10539. 5p. (STMPO—298; MCR—81-1770). NTIS, PC A02/MF A01; GPO Dep. Order Number DE84011433.

All components/parts of the heliostat system were designed and selected for long life. Only a few electrical items and the mirror module doublers had to be replaced/repaired during installation, test, and final checkout. After all initial failures are identified and corrected, daily routine operation should be relatively trouble-free. The 93 heliostats installed in Spain have been operational for four months, with only four electrical failures. Table I gives a listing of all components used, spares provided, additional spares recommended, estimated lead time, and source. Table II gives a listing of manufacturer/supplier addresses for each component.

28120 **(DOE/SF/10539—13) Control system theory of operation.** (Martin Marietta Corp., Denver, CO (USA). Denver Div.). Jan 1982. Contract AC03-80SF10539. 10p. (STMPO—300; MCR—82-1701). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE84011438.

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Control of the field of heliostats is accomplished by means of a distributed computer control system consisting of a minicomputer located in the plant control room and a network of data buses and microcomputer-based controllers located at the heliostats. The reflective surface on each heliostat is rotated about azimuth and elevation axes by means of a gear-drive unit and electric motors. The actual azimuth and elevation angles are determined by means of incremental optical encoders and a microcomputer, and the microcomputer provides the logic to turn the drive motors on and off as required.

28121 **(DOE/SF/10539—16) Collector subsystem heliostat readiness test: test procedure 101. Revision 0.** Rose, G.R. (Martin Marietta Aerospace, Denver, CO (USA)). 4 Aug 1981. Contract AC03-80SF10539. 17p. (STMPO—566). NTIS, PC A02/MF A01; GPO Dep. Order Number DE84012464.

The objectives of this test are to: verify that the heliostat field is cleared of all obstacles which could impede or damage heliostats in motion; identify to the HAC operator any heliostats which are not in service; and verify that collector field power has been applied in accordance with procedure 821, 4160V Collector Field System and 826, 208V Collector Field System.

28122 **(DOE/SF/10539—17) Collector subsystem Dual Heliostat array controller test procedure 106.** Rose, G.R. (Martin Marietta Aerospace, Denver, CO (USA)). 21 Aug 1981. Contract AC03-80SF10539. 20p. (STMPO—567). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE84012463.

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The objective of this document is to demonstrate that the Dual Heliostat Array Controller establishes and maintains communication such that, the backup (secondary or HAC B) system is able to perform the complete HAC task with minimum disruption in the event of a switchover, senses failover of the prime system and initiates and controls CPU and peripheral switchover, and prevents interference from a failed prime system.

28123 **(DOE/SF/10539—19) Collector substystem heliostat targeting verification: Test Procedure 116.** Rose, G.R. (Martin Marietta Corp., Denver, CO (USA). Denver Aerospace). 10 Aug 1981. Contract AC03-80SF10539. 33p. (STMPO—569). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE84012470.

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The objectives of this test procedure are: (1) to demonstrate that the correct heliostat targeting data for the receiver has been incorporated into the Heliostat Array Controllers (HAC) software by visually observing heliostat beams on the receiver; (2) to demonstrate that the HAC Graphics CRT displays the correct aim-point array and corresponding x, y and z target values selected; and (3) to demonstrate the HAC capability to select, control and display up to 20 sets of aimpoint tracking arrays.

28124 **(DOE/SF/10539—20-Rev.A) Collector subsystem official performance test: Test Procedure 118. Revision A.** Rose, G.R. (Martin Marietta Corp., Denver, CO (USA). Denver Aerospace). Sep 1981. Contract AC03-80SF10539. 23p. (STMPO—570). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE84012472.

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The first objective is to demonstrate the heliostat beam quality by taking beam quality data with the BCS. Beam quality data, shall be taken at two different times per day for each heliostat. Beam quality data for a group of ten heliostats at a given time will be combined as follows to yield a composite beam shape for the group: the centroids of each beam shape will be superimposed by the BCS; the flux values at each BCS grid point will be numerically summed; and the summed fluxes at each point will be divided by ten. The composite beam shape for each group of heliostats will be assumed to represent the beam shape of a single heliostat in the group and will be analyzed using HELIOS to ASSESS compliance with the beam quality specification over the operating temperature range. The second objective is to demonstrate that the beam centroid tracking error for each heliostat is within the tracking error specification. Beam centroid tracking data shall be acquired using BCS. Tracking error data for each heliostat will be compared with the specification value of the RMS error.

28125 **(EPRI-AP—3285-Vol.2) 10-MW(e) solar-thermal central-receiver pilot plant. Volume 2. Project documentation. Final report.** Criner, D.E.; Gould, G.L.; Soderstrum, M.G.; Ege, H.D.; Wolfs, K.E. (Burns and McDonnell Engineering Co., Kansas City, MO (USA)). Mar 1984. 634p. EPRI-RRC, Box 50490, Palo Alto, CA 94303. Order Number DE84920373.

The Solar One project is a 10-MWe solar thermal central receiver pilot power plant in operation near Barstow, California. The purpose of the Solar One project is to develop information and data to help assess the feasibility of larger, commercial solar thermal central receiver generating stations. As an energy research and development project, Solar One is producing information that is valuable to the electric utility industry in assessing this technology. The purpose of this study was to review the Solar One project and to identify, from an electric utility perspective, technical lessons learned from the project. These lessons pertain to the design, construction, and initial operation of Solar One. Areas studied include system design features, plant equipment, project organization, plant operations, and environmental impact. In reviewing the project, the

study essentially adopted the perspective of an electric utility or its architect-engineer and focused upon those aspects of Solar One that would be of particular interest to such organizations. In addition to identifying lessons learned, a second task of the investigation was to prepare a bibliography of the technical reports and other documents for the Solar One project. Such a bibliography was prepared and published as part of Volume 2 of the final report for this study.

28126 **(MTR—79W00104) Atmospheric considerations for central receiver power plants.** Henderson, R.G.; Pitter, R.L. (Mitre Corp., McLean, VA (USA)). Jun 1979. Contract AC01-78ET20553. 155p. NTIS, PC A08/MF A01; 1; GPO Dep. Order Number DE84010994.

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This report documents the results of a study of the effects of atmospheric attenuation, turbulent scattering, and the use of cooling towers on the performance of solar thermal central receiver power plants.

28127 **(PNL-SA—11898) Notes on home-type solar hot water economics.** Drumheller, K. (Pacific Northwest Lab., Richland, WA (USA)). Jan 1984. Contract AC06-76RL01830. 11p. (CONF-840155—1). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE84010680.

From ANS energy contest; Richland, WA, USA (24 Jan 1984).

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Some things to consider before buying a solar hot water system is first discussed. Approximate savings in energy costs for a family of four with a solar hot water system are given. Buying a solar hot water system with money taken out of a savings account and with money borrowed on a bank card is next discussed. Finally, some comments are given on tracking parabolic through solar collectors vs flat plate collectors for residential systems.

28128 **(SAND—81-8192/2) Alternate central receiver power system, Phase II. Volume II. Molten salt receiver. Final report.** (Martin Marietta Corp., Denver, CO (USA). Denver Div.). May 1981. Contract AC04-76DR00789. 668p. NTIS, PC A99/MF A01; 1; GPO Dep. Order Number DE84012622.

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The objective of the Phase II program was to demonstrate the feasibility of the molten salt central receiver power system by conducting a series of experiments and using the results to update the commercial-scale design developed during Phase I of the program. The experiments were directed at two levels of inquiry: materials testing, which is discussed in detail in Volume III of this report; and systems-level testing of a 5 MW/sub th/ molten salt receiver (SRE) which is the subject of this volume. With some exceptions detailed under Conclusions and Recommendations in Chapter VI of this volume, all the pre-test questions have been resolved affirmatively by the program. It is concluded that the state-of-the-art of molten salt receiver technology is sufficiently advanced to permit full-scale demonstration as a next step. Following the introduction and summary the remainder of this report was structured to provide three types of cross-sections through the program. Chapters II and III span through the entire program, including design, build, checkout, and tests. Sections IV-A, IV-B and IV-C represent cross-sections through daily operations; while Sections IV-D, IV-E, and IV-F summarize the results in more technical terms, such as interest to the designer or analyst. The commercial update is presented in Chapter V, including improvements suggested by the SRE program.

28129 **(SAND—84-0506C) Heat loss studies.** Meyer, R.D. (Sandia National Labs., Albuquerque, NM (USA)). 1984. Contract AC04-76DP00789. 29p. (CONF-8406111—1). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE84010268.

From International Energy Agency workshop on the design and performance of large solar thermal collectors; San Diego, CA, USA (11 Jun 1984).

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During the course of engineering evaluation of various solar thermal systems at Midtemperature Solar Systems Test Facility (MSSTF), a substantial discrepancy was observed to exist between the predicted and the measured heat loss from the thermal energy transport and storage systems. The heat loss predictions were based on conduction rates computed from manufacturers data for the insulation used on these systems. A series of experiments were initiated to verify the insulation model and to measure the relative contribution of system components such as pumps, anchors, hand and control valves. Additional heat loss data was gathered from the facility at Coolidge. Further investigations were made into natural convection in both piping and storage systems. These studies indicated that the higher than predicted heat losses were due to underestimating the contribution of components such as valves and that the process of convective exchange to inactive branch lines was not considered. It was discovered that much of the heat loss due to thermal siphoning could be eliminated by simple changes in piping geometry.

28130 **(SAND—84-8717) Estimating convective energy losses from solar central receivers.** Siebers, D.L.; Kraabel, J.S. (Sandia National Labs., Livermore, CA (USA)). Apr 1984. Contract AC04-76DR00789. 68p. NTIS, PC A04/MF A01; 1; GPO Dep. Order Number DE84010919.

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This report outlines a method for estimating the total convective energy loss from a receiver of a solar central receiver power plant. Two types of receivers are considered in detail: a cylindrical, external-type receiver and a cavity-type receiver. The method is intended to provide the designer with a tool for estimating the total convective energy loss that is based on current knowledge of convective heat transfer from receivers to the environment and that is adaptable to new information as it becomes available. The current knowledge consists of information from two recent large-scale experiments, as well as information already in the literature. Also outlined is a method for estimating the uncertainty in the convective loss estimates. Sample estimations of the total convective energy loss and the uncertainties in those convective energy loss estimates for the external receiver of the 10 MWe Solar Thermal Central Receiver Plant (Barstow, California) and the cavity receiver of the International Energy Agency Small Solar Power Systems Project (Almeria, Spain) are included in the appendices.

28131 **(SERI/TP—252-2334) Direct absorption receiver.** Copeland, R.J. (Solar Energy Research Inst., Golden, CO (USA)). Apr 1984. Contract AC02-83CH10093. 6p. (CONF-8404139—1). NTIS, PC A02; 3; GPO Dep. Order Number DE84004504.

From Solar central receiver annual meeting; San Diego, CA, USA (24 Apr 1984).

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The research objective is to provide the scientific and technical base for the design of a direct absorption and thermal storage system for high-temperature solar thermal applications, thus, demonstrating the technical feasibility of the system concept. At this stage the research is generating data from which commercial-scale central receiver systems can be designed and the economic potential can be assessed. The research currently emphasizes modeling of the direct absorption process and measurements of liquid-film flow characteristics. Experiments on thin films and molten carbonate salt will also be performed.

1408 Ocean Energy Systems

28132 **(ANL/EES-TM—244) Far-field model of the regional influence of effluent plumes from Ocean Thermal Energy Conversion (OTEC) plants. Progress report, August 1982-March 1983.** Wang, D.P. (Argonne National Lab., IL (USA)). Apr 1983. Contract W-31-109-ENG-38. 19p. NTIS, PC A02/MF A01; GPO Dep. Order Number DE84011528.

Operation of an ocean thermal energy conversion (OTEC) facility results in discharge of large volumes of cold water into the upper ocean. A three-dimensional model was developed to take account of the effects of such discharges. The model provides a means to examine the regional influence of the far-field effluent plume. Initial application of the model to the case of discharge

from a 40-MW/sub e/ OTEC facility into coastal waters indicated that the plant effluent became confined to the top of the thermocline, with a horizontal extent of the discharge on water-column constituents will be influenced by the circulation induced in the upper ocean by the discharge. Onshore motions are induced near the surface, while offshore motions are induced at the top of the thermocline. Associated with this circulation pattern is a strong convergence toward the plume.

28133 **(CONF-7709231—1) Ocean thermal energy: status and prospects.** Avery, W.H. (Johns Hopkins Univ., Laurel, MD (USA). Applied Physics Lab.). 1977. Contract AI01-77ET20342. 9p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE84009336.

From Marine Technology Society meeting on the economic potential of the ocean and the American Institute of Mining, Metallurgical and Petroleum Engineers; Rosslyn, VA, USA (15 Sep 1977).

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A brief overview is given of the ocean thermal energy conversion program at the Applied Physics Laboratory. A brief background is first given of the OTEC concept. The following concepts are then discussed: TRW's 100-MWe, dynamically positioned, surface-vessel-type OTEC plant concept; The APL/JHU concept for a 100-MWe(net), 313-short-ton/day, OTEC/ammonia demonstration plant-ship for siting in tropical oceans; the ARCO LPG floating storage facility; and the OTEC-ammonia-fuel cell system.

28134 **(DOE/CE/30719—T2) Ocean Energy Technology Program summary, FY 1980-1983.** (Meridian Corp., Falls Church, VA (USA)). Sep 1983. Contract AC01-82CE30719. 129p. NTIS, PC A07/MF A01; 1; GPO Dep. Order Number DE84012052.

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A summary of the experience gained through activities sponsored by the US Department of Energy's Ocean Energy Technology Division (DOE/OETD) was performed with the purpose of providing the private and public sectors with information upon which to base future technology development decisions. The program summary was conducted to only reflect FY 80-83 activities, since documentation of pre-FY 80 program activities is readily available. The summary is structured to coincide with the current management organization. Each summary is the product of extensive technical literature reviews, management report reviews, and discussions with key DOE personnel and representatives from the six lead field organizations. Each section is focused on reviewing the major activities and explaining the progression of these activities from a management decision making perspective. In addition, included in each section is a summary of major areas of future investigation and a list of major activities by fiscal year.

28135 **(DOE/ET/20312—5) Heat exchanger evaluation for the Ocean Thermal Energy Conversion program. Final report.** Bell, K.J. (Oklahoma State Univ., Stillwater (USA). School of Chemical Engineering). 17 Feb 1983. Contract AS05-76ET20312. 10p. NTIS, PC A02/MF A01; GPO Dep. Order Number DE84009790.

To update information on OTEC heat exchanger design, and to evaluate new concepts as quickly as possible, this project required the following tasks: (a) Help maintain the overall schedule for OTEC research, development, and deployment. (b) Identify areas of heat transfer technology in which exchanger system design methods and operating experience exist in largescale process plants and are applicable to ocean thermal power plants. (c) Develop procedures to ensure that system analysts are supplied with pertinent heat exchanger design and operational parameters. (d) Perform quick-look analysis and evaluation on any variation in heat exchanger system configuration that seems to show promise for improvements in OTEC plant construction or operation. Under this contract, the Principal Investigator participated in numerous design evaluation and review sessions, the Technical Advisory Panels for the PSD I and II heat exchangers, planning sessions for R and D and test programs, evaluations of laboratory and field experimental data, and meetings on the Open-Cycle Concepts. Work has also been done in developing fundamental analytical techniques for enhanced condensing surfaces.

28136 **(DOE/ET/20342—T11) Ocean thermal energy conversion: an alternate source for ammonia.** Babbitt, J.F.; Francis, E.J. (Devco International, Inc. (USA); Johns Hopkins Univ., Laurel, MD (USA). Applied Physics Lab.). 1979. Contract AI01-77ET20342. 14p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE84009326.

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A historical overview is presented on the concept of OTEC and on the feasibility of producing ammonia and power for OTEC plants. Some technical details of a 40 MW pilot plant are discussed.

28137 **(UCLA-ENG—8307) Experimental investigation of interfacial shear in downward, two-phase, annular, co-current flow with diameter effects.** Hajiloo, M. (California Univ., Los Angeles (USA). School of Engineering and Applied Science). Feb 1983. Contract FG02-80CS89501. 94p. NTIS, PC A05/MF A01; 1; GPO Dep. Order Number DE84011391.

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An experimental rig has been designed and built to provide two phase annular cocurrent downward flow of air and water in tubes of four different inside diameters, ranging from 1.563 cm - 4.127 cm. Flow rates of the phases and static pressure drop were measured over a range of liquid film Reynolds numbers from 5000 to 26,700, and a range of air Reynolds numbers of 4500 to 21,400. The resulting data for the skin friction coefficient are in qualitative agreement with most previously obtained pertinent data. Various ways of presenting the data are explored and discussed, including the use of superficial, true, and relative gas velocities. The effect of the controlled parameters on the skin friction coefficient is discussed, and the importance of the dependence of skin friction coefficient on tube diameter is emphasized.

28138 **(UCLA-ENG—8308) Experimental study of evaporation from round turbulent water jets.** Ofer, S. (California Univ., Los Angeles (USA). School of Engineering and Applied Science). Feb 1983. Contract FG02-80CS89501. 96p. NTIS, PC A05; 3; GPO Dep. Order Number DE84011392.

Paper copy only, copy does not permit microfiche production; Thesis.

New experimental data for liquid side heat transfer coefficients in round turbulent water jets are presented. Evaporation experiments were performed on turbulent water jets ($8000 < Re < 28,000$) where saturation temperature was maintained at 7° to 20°C and parameters varies were jet diameter, length and velocity. Nozzles were smooth long glass tubes having diameters of 1.8, 2.4, 2.8, 3.4, 4.0, 5.0 and 5.6 mm. The jet length varied from 0.625 to 6.75 inches and the water velocity from 3 to 12 m/s. The resulting correlation for the Stanton number indicates no dependence on jet diameter. An average Stanton number for the parameter range of all experiments was 0.00178. Since liquid properties were kept almost constant, care should be taken before extrapolating these results to other liquids using correlations based on dimensional analysis. Comparison with previous studies shows that the correlation based on the present work does not extrapolate to the longer lengths (approximately 4x) characterizing those studies. The higher heat transfer rates found for longer jets are thought to be due to jet breakup and resulting large interfacial areas.

28139 **(UCLA-ENG—8309) Mass transfer in round turbulent water jets.** Leininger, T.F. (California Univ., Los Angeles (USA). School of Engineering and Applied Science). Feb 1983. Contract FG02-80CS89501. 53p. NTIS, PC A04; 3; GPO Dep. Order Number DE84011149.

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Based upon the results of earlier theoretical and experimental work, a technique was developed to measure liquid side mass transfer coefficients for round turbulent water jets of varying velocity, diameter and length. The results obtained with this technique exhibited considerable scatter which was demonstrated to be due to severe limitations of the experimental technique. A companion analytical study showed that, contrary to the fully developed assumption of previous investigators, mass transfer in turbulent jets is an entrance region problem, and indicated that a radical change in the experiment design was required to obtain useful information regard-

ing the liquid side mass transfer coefficient. In addition, the analytical study suggests that, within the parameter range of interest, the mass transfer coefficient for a turbulent jet may be taken to be the same as for a laminar jet since the developing concentration boundary layer never penetrates deeply into the region where turbulent transport is significant.

1409 Solar Thermal Utilization

REFER ALSO TO CITATION(S) 28062, 28182, 28184, 28189, 28630, 28633, 28637

28140 **(BMFT-FB-T—83-300) Technical utilization of solar energy - conversion of solar to thermal energy, solar cooling and thermal energy storage.** Arafa, A.; Fisch, N.; Hahne, E.; Kraus, K.; Seemann, D.; Seifert, B.; Sohns, J.; Schetter, G.; Schwaigerer, W. (Bundesministerium fuer Forschung und Technologie, Bonn (Germany, F.R.)). Dec 1983. 177p. (In German). NTIS (US Sales Only), PC A09. Order Number DE84751230.

Paper copy only, copy does not permit microfiche production; With 98 refs., 24 tabs., 110 figs.

Experimental and theoretical studies in the field of solar energy utilization have been carried out. The main subjects referred to are: Short and long term tests of flat plate watercollectors; Performance of solar absorbers; Tests of air collectors; Solar absorption cooling; Laboratory investigations of flat plate collectors using an artificial radiation source; Thermal stratification in hot water tanks; Investigation of a model of an aquifer store; Properties of phase change materials; Charging an discharging of a latent heat store; Economy of space heating systems.

28141 **(CAPE—2940) Nuuanu YMCA solar water-heating project (Engineering Materials).** 13 Aug 1978. Contract FG03-77CS31640. H. Order Number DE84012400.

7 35-mm aperture cards.

The Nuuanu YMCA is a combination athletic facility and men's dormitory. The building is of masonry construction, and includes a four-story dormitory on which the solar water heating system was mounted. The water storage tank was placed at a higher elevation than the collectors so that the majority of the system would operate in thermosyphon. A small system with a pump is included on another roof of the building and is circulated into the same storage tank. A pump was later added to the thermosyphon system. The system has 182 collector panels, each consisting of a polycarbonate box, low iron tempered glazing, copper waterways and painted aluminum absorber. The water is stored in a 4000-gallon storage tank on the roof. The system provides domestic hot water and serves as a preheat system for the existing building water heaters. The system was installed and met performance criteria. An acceptance test plan is described and data are given. The thermosyphon system was found not to be efficient compared to the pumped system. System operation, maintenance and controls are described, and YMCA energy consumption data are given. Blueprints are included. These Drawings accompany report No. DOE/CS/31640-T1. (LEW)

28142 **(DOE/BP—149) Solar home show 2.** (USDOE Bonneville Power Administration, Portland, OR). Jan 1983. 51p. NTIS, PC A04/MF A01; 1; GPO Dep. Order Number DE84010331.

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In the spring of 1981, Bonneville Power Administration launched the Passive Solar Homebuilder Program in Portland, Oregon, and Spokane, Washington. The program's goal was not to create state-of-the-art solar designs, but rather to demonstrate to builders, designers, realtors and the public that passive solar homes can be attractive, affordable, functional and, therefore, marketable. Thirteen builder-designer teams were selected to design and build a home for the Portland Parade of Homes held in June, 1982. Ten teams were selected for the Spokane Home Show held in August, 1982. The Parade and the Home Show were cosponsored by the Home Builders Associations of Portland and Spokane and the Washington Water Power Company. This book features the BPA-approved designs for the program.

28143 **(DOE/CE—0070) Space heating with active solar energy systems.** (Conservation and Renewable Energy Inquiry and Referral Service, Silver Spring, MD (USA)). Jan 1984. 5p. NTIS, PC A02/MF A01; GPO Dep. Order Number DE84010657.

This information brochure gives the basic principles involved in space heating with active solar energy systems.

28144 **(DOE/CE/15095—8) Solar greenhouses and sunspaces: lessons learned.** (National Center for Appropriate Technology, Butte, MT (USA)). Jan 1984. Contract AC01-82CE15095. 37p. NTIS, PC A03/MF A01; GPO Dep. Order Number DE84007097.

The experiences of the DOE Appropriate Technology grantees provide valuable information for others to use in building and operating better sunspaces and greenhouses. Their experiences are the basis for Solar Greenhouses and Sunspaces: Lessons Learned. This publication is divided into six major categories: design; construction tips; management, maintenance, and safety; horticulture; greenhouse construction workshops; and information sources. Each chapter presents basic background material on the topic and relevant information from selected project reports. A question and answer format is used to present information on ways greenhouses and sunspaces can be improved. This publication has been developed as a supplement to the existing literature to help prospective sunspace/greenhouse owner/builders get started in the right direction. It is not a text book, and is not a substitute for any of the good "how-to" greenhouse books available. Its purpose is to identify common mistakes in design, construction and/or operation that affect performance, and provide useful advice to help consumers avoid these mistakes.

28145 **(DOE/CH/10122—23) Analysis of field test data from domestic solar water heaters in the southern United States, period through March, 1983.** (ESG, Inc., Atlanta, GA (USA)). Mar 1984. Contract AC02-82CH10122. 127p. NTIS, PC A07; 3; GPO Dep. Order Number DE84008544.

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During the field test program there were over 160 solar water heaters monitored for energy performance. The actual installation of the monitoring equipment was divided into two phases. Phase I of the program consisted of the installation of monitoring equipment on solar waterheater sites located in Florida. Phase II called for system monitoring in the state of North Carolina, Virginia, South Carolina, Georgia, Kentucky, Texas, and Alabama. Phase I was implemented in mid 1981 while Phase II began in early 1982.

28146 **(DOE/CS/30156—T2) Iowa Project-Passive. Final report.** (Iowa Energy Policy Council, Des Moines (USA)). 31 Jan 1984. Contract AC02-79CS30156. 141p. NTIS MF A01; 2; GPO Dep. Order Number DE84010864.

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The Iowa Project Passive program was designed to introduce passive solar technology into community college building trades curricula. The center of this program was the construction of a passive solar house built by four Iowa community colleges in lieu of the more typical house which these college building trade programs usually built. The primary purpose of this activity was to provide direct hands-on experience for both building trade instructors and students in the construction of a passive solar home. Additional aspects of the program were to provide both tangible demonstrations of this technology and to provide focal points for the distribution of information to the building industry and general public in the communities surrounding each school. As of the time of this final report, three community college programs have completed the Iowa Project Passive home. Open houses and other outreach type activities have been held at each of the three schools which have completed their construction. The performance of these solar homes is presented.

28147 **(DOE/CS/30379—T1) Pan abode naturally passive solar homes.** Steel, G.B. (Steel (Gerald B.), Rancho Santa Fe, CA (USA)). Mar 1981. Contract FC02-80CS30379. 114p. NTIS, PC A06/MF A01; 1; GPO Dep. Order Number DE84009851.

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Currently Pan Abode markets 30 stock models of solid timber homes. In these homes the interior and exterior walls are of solid timber construction. Wall timbers, made from Western Red Cedar, are precut at the factory in Renton, Washington and then shipped to the site for assembly. Once at the site, the wall timbers are stacked according to the approved plans with timbers laid up throughout the house one course at a time. Ceilings in the Pan Abode homes are exposed beam with 2" x 6" sheathing. The large amount of exposed wood in the Pan Abode homes naturally provides the thermal mass necessary for a high performance passive solar home. The best selling stock model for Pan Abode is the Standard Cavalier. Because this home is the best selling model, it is selected as the base case for the development of a passive solar product line. The design objective is to modify the Standard Cavalier making use of its natural thermal mass to provide significantly improved thermal performance while minimizing any increases in the first costs attributed to passive solar design. Two generic passive solar systems are considered in the design process. The first system is "direct gain." In this system the south windows are used to collect winter sun and the natural thermal mass inside the home is used to moderate the interior temperatures, storing and releasing solar heat, as necessary. The second system provides for a room addition to the basic house of an Energy Wing Solarium. The Energy Wing provides improved thermal performance to the Cavalier and provides a sun room, as well. In this system south facing windows on the Energy Wing collect sunlight in the winter. The design options, thermal performance, market and cost are discussed.

28148 **(DOE/CS/30569—30) Performance evaluation of an active solar cooling system utilizing low cost plastic collectors and an evaporatively-cooled absorption chiller. Final report.** Lof, G.O.G.; Westhoff, M.A.; Karaki, S. (Colorado State Univ., Fort Collins (USA). Solar Energy Applications Lab.). Feb 1984. Contract AC03-81CS30569. 140p. NTIS, PC A07/MF A01; 1; GPO Dep. Order Number DE84010813.

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During the summer of 1982, air conditioning in Solar House III at Colorado State University was provided by an evaporatively-cooled absorption chiller. The single-effect lithium bromide chiller provided by Arkla Industries is an experimental three-ton unit from which heat is rejected by direct evaporative cooling of the condenser and absorber walls, thereby eliminating the need for a separate cooling tower. Domestic hot water was also provided by use of a double-walled heat exchanger and 300-l (80-gal) hot water tank. For solar heat supply to the cooling system, plastic thin film collectors developed by Brookhaven National Laboratory were installed on the roof of Solar House III. Failure to withstand stagnation temperatures forced replacement of solar energy with an electric heat source. Objectives of the project were: (1) evaluation of system performance over the course of one cooling season in Fort collins, Colorado; (2) optimization of system operation and control; (3) development of a TRNSYS compatible model of the chiller; and (4) determination of cooling system performance in several US climates by use of the model.

28149 **(DOE/CS/32129—T1) Final report on the E-complex building.** Farrer, R.; Cherng, J. (New Mexico Solar Energy Inst., Las Cruces (USA)). 1984. Contract FC03-78CS32129. 134p. NTIS, PC A07; 3; GPO Dep. Order Number DE84009203.

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The E-Complex Building at New Mexico State University provides about 40,000 square feet of usable space for engineering laboratories, classrooms, and offices. An additional 5000 square feet of solar test and work area is provided on the roof. The building incorporates both active and passive solar systems. The single-story office space on the south side of the building is heated passively by 1400 square feet of south-facing double-glazed windows, which should supply 10 percent of the design heat load of the building. An active air-type solar system, with 4400 square feet of solar collectors and 5200 cubic feet of rock for thermal storage, should provide 65 percent of the design heat load. In addition, the rock storage can be cooled in summer by drawing outside air through an evaporative cooler at night and passing it through the rocks. The cool storage can be used to offset some of the summertime cooling load of the building by passing building ventilation air through the rocks. In this report, the solar systems are described in detail and the principles of operation of the active system are described. Problems encountered during construction of the building are discussed. The "Acceptance Test Plan" for the solar system is included; test results obtained are presented and discussed. A final section contains conclusions and recommendations concerning the solar system. An Operation and Maintenance Manual for the system is under separate cover.

28150 **(DOE/CS/32129—T2) Operation and maintenance manual for the Solar Air System in the E-Complex Building at New Mexico State University.** Cherng, J.G.; Farrer, R.G. (New Mexico Solar Energy Inst., Las Cruces (USA)). Feb 1982. Contract FC03-78CS32129. 241p. TIC, PO Bx 62, Oak Ridge, TN 37831. Order Number DE84009416.

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The solar heating system includes air-type solar collectors, an in-line centrifugal collector supply fan, motorized dampers installed in critical locations in the duct work, a differential temperature controller that automatically cycles the solar collection system, the insulated vessel containing the energy storage medium (in this case, common rocks), and backup heating/cooling coils inserted in the heating and cooling supply ducts. The backup heating and cooling coils are connected to the university's central heating and cooling plant, adjacent to the E-Complex building, through circulating pumps and piping that runs in an underground tunnel to the building. The rock storage system can be cooled in summer using outdoor air that is drawn in through air washers at night. The cool rocks can be used to help cool the building air during the day. The major function and the designed specifications of these key components are discussed. Operation, control, and maintenance procedures are treated in detail.

28151 **(DOE/CS/32197—3) TRW/Ore-Ida potato processing project test and evaluation phase. Final report.** Cherne, J. (TRW Energy Development Group, Redondo Beach, CA (USA)). 30 Apr 1983. Contract AC03-78CS32197. 58p. (SAN—2197-3). NTIS, PC A04/MF A01; 1; GPO Dep. Order Number DE84007878.

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A solar industrial process steam system was designed and installed at the potato processing plant owned and operated by Ore-Ida Foods, Inc., in Ontario, Oregon. The system consists of fourteen rows of Suntec Model SH1655 parabolic trough collectors having a gross aperture of 10,000 square feet with an effective area of 9212 square feet. This final report covers the test and evaluation phase which includes the following activities: System operation and a maintenance, preparation of an O & M manual, training the plant personnel in operation of the system, engineering support for operation of the system, data reduction of the system performance and preparation of the final report.

28152 **(DOE/CS/34034—T1) Solar system for a solar cooled school building in a subtropical region. Final report.** (Mueller Associates, Inc., Baltimore, MD (USA)). Mar 1984. Contract FC03-77CS34034. 36p. NTIS, PC A03/MF A01; GPO Dep. Order Number DE84010418.

The primary objective of this project was to design a school facility, located in a subtropical environment, which would utilize solar energy to provide 70% of the energy required annually for cooling, and domestic hot water heating. Key design goals were: cost effectiveness, equipment reliability, ease of maintenance, and simplicity and economy of operation. The facility is a two-story elementary school building in Miami, Florida containing approximately 6500 m^2 (70,000 sq. ft.) gross floor areas, and a detached mechanical equipment building. The flat-plate collector system pro-

vides an energy collection surface of 1983 m^2 (21,350 sq. ft.) mounted on a structural aluminum truss system. Water with chemical inhibitors is used to collect and transfer energy to three steel hot water storage tanks with a total capacity of 208 m^3 (55,000 gal.) buried horizontally in the earth berm surrounding the building. Hot water is pumped from the storage tanks through 4 parallel lithium bromide absorption chillers rated at 88 kW (25 tons) each. Domestic hot water is preheated to 60°C (140°F) by use of a heat exchanger in the solar hot water circuit. The solar system design, project delay, developed system problems, and system changes are discussed.

28153 **(DOE/CS/69104—5) Passive solar heating.** (Michigan Dept. of Commerce, Lansing (USA)). [nd]. Contract FG45-80CS69104. 9p. NTIS, PC A02/MF A01; GPO Dep. Order Number DE84009682.

This publication is intended to introduce passive solar heating and cooling concepts.

28154 **(DOE/R5/10243—3) Demonstration of solar/hydrothermal energy system in the Montgomery County Animal Shelter.** (Montgomery County Board of Commissioners, Dayton, OH (USA). Office of Management and Budget). 1984. Contract FG02-80R510243. 122p. NTIS, PC A06; 3; GPO Dep. Order Number DE84009742.

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The solar-assisted heat pump system for the animal shelter uses eight roof collector panels and a 250-gallon above ground storage tank. The system is utilized for preheating the domestic hot water system as well as preheating the well supply for the water source heat pumps. This report includes the following: cover letter; a brief technical report; Andover AC-8 program software; photo display, and "as builts".

28155 **(DOE/R7/01161—T1) Solar greenhouse.** Bachamp, R.E. (Bachamp (Richard E.), Manhattan, KS (USA)). Sep 1981. Contract FG47-80R701161. 8p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE84010013.

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28156 **(DOE/R7/01173—T1) Crete Public School, Crete, Nebraska. Final report.** Morton, M.T. (Morton (Michael T.), Crete, NE (USA)). Feb 1982. Contract FG47-80R701173. 23p. NTIS, PC A02; 3; GPO Dep. Order Number DE84010088.

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A solar greenhouse-solar collector was built to supplement the science rooms. The solar green house serves as a facility which will enable the students a practical solar energy research area, and the Biology Department to investigate the area of horticulture and plant science. The facilities also have a liquid and solid heat storage units which is to be used to supplement the heat to four science rooms. The heat storage consist of the present brick-concrete block and 55 gallon drums for storage of water. The possibility of growing plants hydrophonically to supplement food in our school lunch program is also examined.

28157 **(DOE/R7/01232—T1) Vertical solar wall collector and cover. Final project report, December 1983.** Kahl, D. (Kahl (Dennis), Schuyler, NE (USA)). 30 Dec 1983. Contract FG47-81R701232. 3p. NTIS, PC A02; 3; GPO Dep. Order Number DE84010448.

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28158 **(DOE/R7/01243—T1) Solar energy effectiveness in Kirksville (SEEK). Final report.** (Kirksville, City of, MO (USA)). Dec 1983. Contract FG47-81R701243. 11p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE84010457.

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The project had three basic activities: (1) to build and install solar heating units in homes in the City of Kirksville; (2) to provide training to interested citizens and private contractors in the area on the design and construction of solar units; and (3) to make available to the public the energy saving results of the units constructed. Specific information on each of the 17 units constructed is presented.

28159 **(DOE/SF/10816—T6) Instrumentation selection, installation, verification and calibration at the passive cooling experimental facility for a hot/arid climate.** Peck, J.F.; Mignon, G.V. (Arizona Univ., Tucson (USA). Environmental Research Lab.). Aug 1983. Contract AC03-80SF10816. 175p. NTIS, PC A09/MF A01; GPO Dep. Order Number DE84006253.

The purpose of the Passive Cooling Experimental Facility is to acquire data and perform experiments regarding different passive cooling techniques and strategies. In order to adequately explain the cooling techniques employed, sufficient instrumentation and data logging equipment was installed. Sensors were selected based on their accuracy, cost effectiveness, and ability to calibrate consistently and with ease. The sensors and instrumentation and the basis for their selection, installation, verification and calibration are described. Installation and calibration details are provided for certain selected critical sensors, i.e., heat flux meters, pyrgeometers, etc. The following list summarizes the critical sensors and instruments selected and installed. Heat flux: Hy-Cal Engineering BI-7 thermoelectric sensors; Temperature (wet and dry bulb): Copper-constantine thermocouples, Hewlett Packard reference junction; Pyranometers: Eppley PSP, LICOR photovoltaic pyranometers and Eppley Shadow Band 8 to 48 pyranometer; Infrared Radiometer: Eppley PIR pyrgeometer; Ambient Wind Velocity: Gill Propeller Vane Anemometer by R.M. Young; Air Flow: EII Air Flow Meters; and Infiltration: SF_6 gas chromatography.

28160 **(DOE/SF/11584—T1) Page Jackson solar school, Charles Town, West Virginia. Final technical report.** Frazier, R.H.; Pickett, J.W. (Jefferson County Schools, Charles Town, WV (USA); Pickett-Siess and Associates, Vienna, VA (USA)). Jul 1983. Contract AC03-82SF11584. 95p. NTIS MF A01; 2; GPO Dep. Order Number DE84010420.

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The Page Jackson Elementary School in Charles Town, West Virginia, uses a solar energy system to provide space heating and cooling for a 52,600 sq. ft. school building. A total of 11,215 sq. ft. of PPG Industries, Inc., double-glazed, flat plate collectors (facing south at a 45° tilt from the horizontal) are used in conjunction with glass mirrored reflectors facing north at a 38° tilt from the horizontal) to collect the available solar energy. The solar energy system at Page Jackson is of the drainback type. Space heating for the school is provided by circulating warm water from the storage tanks through five air handling units (AHU's). Space cooling to the building is provided by a 100 ton Trane packaged absorption water chiller when sufficiently hot solar water is available. The solar energy system began operation late in the summer of 1977. In general, the solar energy systemand controls appears to be in good working order. The performance of the system is particularly good; in fact, much better than most. Because the refurbished collector array is now operating at near design conditions, it is anticipated that the system will begin to contribute substantially (as originally intended) to the building load. In order to ensure that the system is operating as designed while in the space cooling mode, it is recommended that the solar cooling subsystem be tested for proper operation and performance during the warmer summer months.

28161 **(LA-UR—83-1294) Passive solar heating and analysis.** Jones, R.W. (Los Alamos National Lab., NM (USA)). 1984. Contract W-7405-ENG-36. 21p. (CONF-8405149—1). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE84011328.

From SOLERAS workshop on solar buildings; Riyadh, Saudi Arabia (5 May 1984).

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Passive solar heating experience and analysis techniques are reviewed with emphasis on annual auxiliary heat requirement. The role of analysis in the design of passive solar buildings is discussed.

Selected results for existing systems are presented for locations in Saudi Arabia and climatically similar locations in the US. Advanced systems in the research stage are described.

28162 **(LA-UR—84-1338) Including the effect of control strategy in solar load ratio calculations.** Wray, W.O.; Kosiewicz, C.E. (Los Alamos National Lab., NM (USA)). 5 Jun 1984. Contract W-7405-ENG-36. 6p. (CONF-840622—5). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE84011344.

From Annual meeting of the American Solar Energy Society; Anaheim, CA, USA (5 Jun 1984).

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As originally developed, solar load ratio correlations for performance analysis of passive heating systems were intended for use only with a constant thermostat setpoint. The thermostat setpoint used in the method may be adjusted to account for the effect of heating from internal sources, but setback or shutdown strategies that are frequantly employed in both residential and commercial buildings were not allowed. A procedure for approximating the effect of various control strategies through use of an equivalent constant thermostat setpoint, T/sub ec/, has recently been developed at Los Alamos National Laboratory. The value of T/sub ec/ depends on the level and duration of thermostat settings used during the diurnal cycle and on the characteristic time constant is a function of the diurnal heat capacity of the building and its loss characteristics. The method described in this paper has been applied to a variety of passive solar buildings in two distinct climatic regions and was found to yield good accuracy when compared with detailed thermal network calculations.

28163 **(LA-UR—84-1428) Materials aspects of solar energy use in buildings.** Moore, S.W.; McFarland, R.D. (Los Alamos National Lab., NM (USA)). May 1984. Contract W-7405-ENG-36. 9p. (CONF-840570—6). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE84012662.

From Materials for future energy systems conference; Washington, DC, USA (1 May 1984).

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Advances in materials for solar energy utilization have the potential to produce large performance improvements (both present and future concepts) in use of solar energy or conservation. Because approximately 26 quads of the total national energy budget of 75 quads is consumed by buildings, solar and conservation improvements can have a large effect on our overall energy consumption. There have been a large number of materials research programs funded through the Department of Energy (DOE) in an attempt to expand the use of solar energy. These materials programs have covered the areas of sealants and gaskets, insulations, glazings, glazing-surface treatments, polymers, selective absorber surfaces, phase-change storage, and heat mirrors. In addition to developing the materials, a large effort has been directed toward determining the reliability and durability of solar materials. The present state of the art and status of these solar materials are discussed. Although much progress has been made in recent years, many improvements are still needed. For many of the more routine materials, simple cost reductions or durability improvements would suffice. For the more advanced concepts of controlling energy flow into or out of buildings, basic materials research remains a necessity. There are a large number of potentially viable concepts that appear promising but have not yet been developed into usable materials.

28164 **(NBS-TN—1187) Performance criteria for solar heating and cooling systems in commercial buildings.** (National Bureau of Standards, Washington, DC (USA). Center for Building Technology). Apr 1984. Contract AI01-76PR06010. 232p. NTIS, PC A11/MF A01; 1; GPO Dep. Order Number DE84010817.

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This document establishes baseline criteria for the design, development, technical evaluation and procurement of solar heating and cooling systems for commercial buildings. These performance criteria were developed in accordance with Public Law 93-409 the Solar Heating and Cooling Demonstration Act of 1975. The document is intended as a resource for use in establishing minimum acceptance levels of performance for solar heating and cooling systems. Criteria which deal with public health and safety are in compliance with general building codes and standards. The criteria on thermal and mechanical performance, durability/reliability and operation/servicing present performance requirements considered to be representative of acceptable levels for conventional space conditioning equipment. By the use of performance language in the document, it is believed that sufficient latitude has been provided to allow innovation and flexibility that is essential for the stimulation of a viable solar industry.

28165 **(NBSIR—84-2845) Test methods and standards development for active solar heating and cooling systems.** Trechsel, H.R.; Collins, B.L. (National Engineering Lab. (NBS), Washington, DC (USA)). May 1984. Contract AI01-76PR06010. 143p. NTIS, PC A07/MF A01; 1; GPO Dep. Order Number DE84010545.

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Since test methods and standards for active solar heating and cooling systems did not exist in 1976, the Department of Energy sponsored research at the National Bureau of Standards (NBS) and other laboratories to aid in the development of research-based standards. This research was intended to facilitate a sound data base for the development of national consensus standards and test methods. In the present report, research by NBS and other laboratories is described for solar domestic hot water systems, solar collectors, thermal storage devices and collector materials. For collectors, the report describes research and test methods for determining the performance of cover plates, absorber materials, collector insulation, gaskets and sealants, rubber hose, containment materials, and heat transfer fluids.

28166 **(NMERDI—2-71-4518) Low-Cost Batch Solar Water Heater Research and Development Project: results from extended field monitoring. Final report, January 1, 1983-May 15, 1983.** Stickney, B.L. (New Mexico Solar Energy Association, Santa Fe (USA)). Feb 1984. 16p. New Mexico Energy Research and Development Institute Information Ctr., University of New Mexico, Suite M, 457 Washington SE, Albuquerque, NM 87108. Order Number DE84900891.

This report contains the results of a four month field test and evaluation of a 30 gallon inverted batch solar water heater known as the Bottomgainer. It was installed on a residence in Santa Fe and monitored with automatic data recorders including solar radiation meter, dual channel Btu meters, water meter and 16 channel strip chart temperature recorder. Average values of heat gain, heat loss, collection efficiency, solar heating fraction and cash benefits are presented and discussed.

28167 **(NP—4901193) Passive solar design for Arizona.** Kessler, H.J. (Arizona Solar Energy Commission, Phoenix (USA)). Mar 1983. 33p. Arizona Solar Energy Commission, Capital Tower, Room 502, 1700 West Washington, Phoenix, AZ 85007 $3.00. Order Number DE84901193.

This booklet provides information for homeowners in Arizona who are interested in adding solar to their homes in the form of greenhouses, solar porches, and other devices. It describes some passive design principles; the first steps to climate sensitive design; controllable solar access techniques; and cooling design strategies. It also discussed tax credits for passive solar homes and provides recommended readings.

28168 **(NP—4901215) Solar water heating for Arizona homes.** Anderson, M.R.; Balon, R.J. (Arizona Solar Energy Commission, Phoenix (USA)). May 1983. 40p. Arizona Solar Energy Commission, Capital Tower, Room 502, 1700 West Washington, Phoenix, AZ 85007 $3.00. Order Number DE84901215.

This booklet gives the information necessary to make an informed decision about whether solar water heating is right for you and what type and size of system are appropriate for you. The material is organized into five independent sections: Section 2 shows the homeowner how to assess how much is being spent on water heating and the monetary savings one might expect with solar

water heating; Section 3 describes the differences between types of solar water heaters. Their physical differences are noted, and their general suitability to domestic water heating is discussed; Section 4 provides two specific methods by which one can compare systems being sold. The methods utilize a collector rating or a system rating. In order to be eligible for tax credits, the collector or system must have been rated by an approved agency; and Section 5 describes results of an experimental comparison of solar water heaters. The year long study was carried out at the Solar Energy Research Laboratory of Arizona State University and was funded by the Arizona Solar Energy Commission, the Salt River Project and the Arizona Public Service Company.

28169 **(PB—84-152685) Solar/gas water heater characterization and development. Final report, November 81-Jun 83.** Cohen, B.M.; Persons, R.W.; Harris, M.J.; Arora, R. (Thermo Electron Corp., Waltham, MA (USA)). Nov 1983. 561p. (TE—4306-134-83). NTIS, PC A24/MF A01.

An experimental and analytical study was completed which comparatively characterized current options for solar/gas water heaters and which identified and evaluated avenues to improvement. Both solar and conventional water heaters were tested in order to understand the unique qualities which differentiate generic designs. Results of testing were used to modify and validate computer simulations describing their performance. With little exception, modeling was accomplished using the TRNSYS computer program with modifications. The program ultimately relied upon life-cycle cost analysis to evaluate the systems. Energy usage was derived from annual system performance simulations using TRNSYS and costs for equipment and energy as well as predictions of future trends such as escalation rates were derived from other sources. The major performance obstacle to efficient gas backup for solar was identified as standby losses in the center-flue design. The major economic obstacle to combined system success was identified as the installed cost of the solar system. Thermosyphon preheat systems, where viable, and direct preheat systems with freeze protection are closest to economic viability.

28170 **(PB—84-163534) Heat storage units using a salt hydrate as storage medium based on the extra water principle.** Furbo, S. (Commission of the European Communities, Luxembourg). [nd]. 126p. (EUR—8169-EN). NTIS, PC E07/MF E07.

A heat of fusion storage unit using a salt hydrate for solar heating systems for domestic hot water supply was constructed and examined experimentally with five different storage materials. These were salt hydrates based on the extra water principle, a heat of fusion storage method demonstrated in two earlier projects. Calculations of the total yearly utilized solar energy for small solar heating systems for domestic hot water supply were carried out, both with hot water tanks and heat of fusion storage units as heat stores. Based on these calculations the advantages of using heat of fusion storage units as heat stores. Based on these calculations the advantages of using heat of fusion storage units rather than hot water tanks in small solar heating systems for domestic hot water supply were established.

28171 **(SERI/TP—253-2288) Assessment of historical R & M data for SDHW systems.** Jorgensen, G.J. (Solar Energy Research Inst., Golden, CO (USA)). Mar 1984. Contract AC02-83CH10093. 8p. (CONF-840622—6). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE84004495.

From Annual meeting of the American Solar Energy Society; Anaheim, CA, USA (5 Jun 1984).

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This paper consolidates relevant reliability and maintainability (R & M) information based on documented findings from field installations. Data from government sponsored demonstration projects, utilities, private consultants, and owner surveys are included. Failure rates and problem frequencies are emphasized rather than guidelines and experiences, which have been compiled elsewhere. R & M issues concerning solar energy systems, subsystems, and components are reviewed. The information presented is based upon 20 applicable R & M studies. Whenever possible, analogous data from the various studies are compared and combined to give a clearer, more complete representation of pertinent R & M issues.

28172 **(SERI/TP—253-2298) Effects of control sensor drift on annual SDHW system performance.** Farrington, R.B.; Short, W. (Solar Energy Research Inst., Golden, CO (USA)). Mar 1984. Contract AC02-83CH10093. 8p. (CONF-840622—11). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE84004497.

From Annual meeting of the American Solar Energy Society; Anaheim, CA, USA (5 Jun 1984).

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The determination of proper control set points for active solar energy systems has been discussed by numerous authors. Varying the differential-off set point has been thought to contribute only additional parasitic energy costs. This work shows that the effect of varying the differential-off set point is much more significant than that. Laboratory testing at the Solar Energy Research Institute has shown that sensor response can drift by as much as 12°C. The sensor testing and results are briefly reviewed. A negative differential-off set point results in an interesting phenomenon. The continued pump circulation keeps the collector sensor warmer than the ambient air and, in fact, will keep it very close to the storage tank temperature. As a result, the pump will continue operating with no irradiation leading to high thermal losses. Analytical expressions have been developed and are presented that determine the ambient air temperature required to turn the pump off as a function of the (negative) differential-off set point and storage tank temperature. The annual effect of this for five differential-off set points was determined for Albuquerque, Fort Worth, Madison, and Washington, DC, using TRNSYS. The results show that a negative differential can effectively reduce the net collected energy by 50% and increase the auxiliary energy requirements by 300%.

28173 **(SERI/TP—253-2299) Component reliability testing.** Farrington, R.B. (Solar Energy Research Inst., Golden, CO (USA)). Mar 1984. Contract AC02-83CH10093. 8p. (CONF-840622—10). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE84004496.

From Annual meeting of the American Solar Energy Society; Anaheim, CA, USA (5 Jun 1984).

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Component and system reliability of active solare energy systems continues to be a major concern of designers, manufacturers, installers, and consumers. Six test loops were constructed at the Solar Energy Research Institute in Golden, Colorado, to thermally cycle active solar energy system components. Drain valves, check valves, air vents, vacuum breakers, tempering valves, and polybutylene pipe were included in the testing. Test results show poor reliabiity of some of the components and limited performance from others. The results lead to a better understanding of certain failures in the field and present designers with realistic expectations for these components.

28174 **(SERI/TP—253-2309) Investigation of means for lowering costs of active solar hot water/space heating systems.** Kutscher, C.F. (Solar Energy Research Inst., Golden, CO (USA)). Mar 1984. Contract AC02-83CH10093. 8p. (CONF-840622—7). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE84004499.

From Annual meeting of the American Solar Energy Society; Anaheim, CA, USA (5 Jun 1984).

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Market penetration studies indicate that in the absence of tax credits, large reductions in the costs of active solar hot water/space heating systems will be necessary. A number of potential means for equipment and labor cost reductions are presented. The use of drainback systems with polybutylene pipe and a variety of low-cost collector concepts is discussed. The pros and cons of the various drainback configurations are described in terms of performance and potential for cost reduction.

28175 (SERI/TP—253-2310) Analysis of an active charge/passive discharge solar space conditioning system. Short, W.; Kutscher, C.F. (Solar Energy Research Inst., Golden, CO (USA)). Mar 1984. Contract AC02-83CH10093. 8p. (CONF-840622—9). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE84004498.

From Annual meeting of the American Solar Energy Society; Anaheim, CA, USA (5 Jun 1984).

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The performance and economics of a hybrid air-based, residential system using 18.5 m^2 of roof-mounted air collectors and a hollow-core slab that discharges directly to the space by radiation and convection was examined. In addition to space heating, the system provides domestic hot water heating and summer cooling by night venting of the slab. The system is assumed to be installed in a fairly tight new house with a floor area of 140 m^2 and 7 m^2 of south-facing glazing. Preliminary slab design parameter sensitivities were examined by simulating the slab under steady-state conditions using a three-dimensional multi-node model. These preliminary findings were employed in developing an annual simulation of the entire system and house using the TRNSYS computer code. A limited number of sensitivity analyses were conducted with TRNSYS. The hybrid system heating performance and economics under the base case conditions were comparable to those of the active/rockbed system. The hybrid system collector outlet temperatures were lower than those of the active system, yet the inlet temperatures were higher, yielding comparable collector efficiency.

28176 (SERI/TP—253-2324) Modeling of the DOE-sponsored IPH field-test experiments. Lewandowski, A. (Solar Energy Research Inst., Golden, CO (USA)). Apr 1984. Contract AC02-83CH10093. 8p. (CONF-840622—8). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE84004501.

From Annual meeting of the American Solar Energy Society; Anaheim, CA, USA (5 Jun 1984).

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Field test experiments were modeled and performance predictions for each project were generated. Additionally, these performance predictions have been compared with actual performance measurements taken at the projects. Performance predictions were generated using SOLIPH, an hour-by-hour computer code with the capability for modeling many types of solar IPH components and system configurations. Comparisons of reported and predicted performance resulted in good agreement and a high level of confidence in the ability to accurately estimate potential solar IPH system energy deliveries.

28177 (UCLA-ENG—8310) Moisture transport in silica gel particle beds. Pesaran, A.A. (California Univ., Los Angeles (USA). School of Engineering and Applied Science). Feb 1983. Contract FG02-80CS84056. 238p. NTIS, PC A11/MF A01; 1; GPO Dep. Order Number DE84011173.

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A theoretical and experimental study of the performance of silica gel packed particle beds is described. A bench-scale test rig was used to obtain data for parameter values pertinent to solar air-conditioning applications. Both adsorption and desorption experiments were performed for Regular Density (RD) silica gel for a wide range of particle size. Adsorption data were also obtained for Intermediate Density (ID) gel. A model of heat and mass transfer in the bed was developed with special attention paid to the modeling of solid side resistance. For this latter purpose an extensive review of the available literature on moisture adsorption and moisture transport in silica gel was made. Both Knudsen and surface diffusion are found to be important mechanisms of moisture transport in Intermediate Density gels while surface diffusion is dominant in Regular Density gels. A general equation for moisture transport in a spherical silica gel particle was developed and was incorporated into the model equations governing heat and mass transfer between the gel particles and air flowing through a packed particle bed. A computer code DESICCANT was written to solve the coupled set of partial differential equations using a finite difference numerical method. The agreement between theory and experiment for adsorption on RD gel is satisfactory, and is somewhat better for the outlet water vapor concentration than for the outlet air temperature. The agreement for desorption from RD gel and adsorption to ID gel is satisfactory, but not as good as for adsorption on RD gel.

28178 (UCLA-ENG—8311) Experimental study of the performance of a laminar flow silica gel desiccant packing suitable for solar air conditioning application. Biswas, P. (California Univ., Los Angeles (USA). School of Engineering and Applied Science). Feb 1983. Contract FG02-80CS84056. 106p. NTIS, PC A06; 3; GPO Dep. Order Number DE84011394.

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An experimental study of the performance of a low pressure drop silica gel desiccant packing has been carried out. The packing is in the form of narrow passages lined with a single layer of small silica gel particles. A near optimum particle size of 0.25 mm, and a range of passage widths of 1.46 to 3.75 mm were chosen based on the predictions of a computer simulation model. A test chamber was constructed with sufficient thermal insulation to allow close to adiabatic conditions for the 12 cm x 12 cm cross section of packing. Step change adsorption and desorption tests were performed for various plate spacings, air flow rates, air inlet conditions, and gel initial water contents. Air outlet moisture content and temperature, as well as pressure drop were measured. The experimental results were compared with predictions of the computer simulation model: This model is based on gas side controlled heat and mass transfer, with the small solid side mass transfer resistance incorporated in a crude manner, and heat transfer into the packing handled as a lumped thermal capacitance. Reasonable agreement was obtained between theoretical prediction and experiment. The match was found to improve with increased passage width. The discrepancies are chiefly attributed to an excessive air bypass, and to inaccurate accounting for heat transfer from the sides of the unit. Use of the computer code for prototype scale design purposes is recommended.

28179 (UCLA-ENG—8312) Development of a laminar flow desiccant bed for solar air conditioning application. Kim, S. (California Univ., Los Angeles (USA). School of Engineering and Applied Science). Feb 1983. Contract FG02-80CS84056. 73p. NTIS, PC A04/MF A01; 1; GPO Dep. Order Number DE84011613.

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Mass transfer in silica gel beds of different configurations is reviewed in connection with use in the Solar-Desiccant-Evaporative Cooling System. A laminar flow, coated-sheet concept is proposed since it ensures a low pressure drop and minimal solid side mass transfer resistance. A preliminary bed design gives 1/3 the pressure drop of a previous packed particle bed design and a large reduction in volume and silica gel inventory. The construction of a packing module and test rig is described, and test results reported for a particle size of 0.12 mm (60 to 200 mesh) with a passage width of about 1.5 mm. In order to compare theory and experiment, an existing code, NUMINT, which solves the partial differential equations governing heat and mass transfer in silica gel beds, was revised to include the effects of substrate heat capacity, and non-adiabatic operation. Comparisons between theory and experiment were found to be generally satisfactory, though it was found that specification of the bed initial water content for adsorption tests presented some difficulties. The effect of solid side mass transfer resistance was found to be small, which suggests that an optimum design may incorporate a larger particle size. Topics for further work are suggested.

1410 Solar Collectors And Concentrators

REFER ALSO TO CITATION(S) 28067, 28078, 28140, 28157, 28158

28180 (CONF-840622—3) Passive stabilization of gradient zone boundaries in solar ponds. Hull, J.R. (Argonne National Lab., IL (USA)). 1984. Contract W-31-109-ENG-38. 7p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE84010475.

From Annual meeting of the American Solar Energy Society; Anaheim, CA, USA (5 Jun 1984).

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The positions of the gradient zone boundaries in the 1080 m^2 Research Salt Gradient Solar Pond at Argonne National Laboratory have been stable for almost three years, even though the thickness of the gradient is larger than that expected by stability arguments of previous studies. The stability is totally the result of passive mechanisms. The lower boundary is continuously maintained by a salt pile at the bottom of the pond, with the top of the pile determining the position of the boundary. The position of the upper boundary cycles over the year. Its yearly average position is maintained by winter ice formation. Stability parameters associated with the upper zone boundary are shown to have a complex hydrodynamics and a large day to day variation.

28181 **(DOE/ET/00089—3) New concentrators for the generation of very high temperatures from solar energy. Final technical report.** Winston, R. (Chicago Univ., IL (USA). Enrico Fermi Inst.). 15 Dec 1983. Contract FG02-79ET00089. 80p. NTIS, PC A05/MF A01; 1; GPO Dep. Order Number DE84006880.

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Nonimaging secondary concentrators of the CEC or "trumpet" type can increase the concentration ratio of parabolic dish primaries so that they approach the so called "thermodynamic limit" for a given optical error budget. Progress covering the three years of research into the development and application of these concentrators with particular emphasis on the trumpet is described. Procedures for optimizing the degree of truncation and secondary concentration ratio for trumpets have been developed and it was shown that in general increases in overall concentration ratio by about a factor of 2 can always be achieved. A detailed analysis of the systems perforamnce improvement of solar thermal engines has shown that in general, use of a secondary trumpet can increase the relative energy output from 8 to 15% depending on the primary and engine characteristics. A hardware project to increase the concentration ratio of a full-scale focussing primary using a trumpet was carried out. Two different experiments to measure the performance of the secondary trumpet have been successfully completed. With the JPL Test Bed Concentrator (TBC) configured for a geometrical concentration of about 4700:1 the trumpet produced a gain in effective intercept factor from 0.74 to 0.96, a relative increase of about 30% in throughput. When deployed at the focal plane of an Omnium G concentrator at the University of Queensland a relative increase of 72% was achieved. In both cases the throughput efficiency of the trumpet was 96% while achieving a gain in overall concentration ratio by a factor of 2.1.

28182 **(DOE/R7/01133—T1) Multiple uses of solar air in ethanol production. Summary report.** Staller, W.; Fuhrken, R. (Jackson County Parks and Recreation, Blue Springs, MO (USA)). Dec 1983. Contract FG47-80R701133. 18p. NTIS, PC A02/MF A01; GPO Dep. Order Number DE84007857.

The Missouri Jackson County Parks and Recreation Department is building an ethanol production plant for conservation of a non-renewable resource. Certain steps in production need to be further developed so as to increase efficiency of the overall operation. The multiple use of solar air for drying of mash residue into animal feed, pre-heating of mash water and drying of stored corn will save installation of natural gas dryers. Drying of the mash residue will prevent spoilage and make the by-product easy to store and use as feed. Pre-heating of mash water will save time and consumption of dampness will facilitate storage.

28183 **(DOE/R7/01170—T1) Development and demonstration of a stationary reflector with tracking absorber (SRTA) solar collector. Final report, September 30, 1980-December 31, 1982.** Kruse, R.W. (Kruse (Richard W.), Fort Calhoun, NE (USA)). Apr 1983. Contract FG47-80R701170. 44p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE84010008.

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This project consisted of designing and building a concentrator type solar collector. The reflector is a 31 foot diameter dish with a mirrored surface. The absorber is a 5-1/2" dia. cylindrical coil 10 feet long, surrounded by a pyrex tube 6" o.d. The reflector is stationary while the absorber tube tracks the sun. Heat is absorbed by a copper coil making up the absorber tube. The heat transfer fluid is a synthetic hydrocarbon with a boiling point of 550°F. The hot fluid is pumped to a 2000 gallon hot water storage tank in a dwelling, where the heat is used for space heating and domestic hot water heating. Due to cost over-runs, only 400 $ft.^2$ of the available 1000 $ft.^2$ was covered with reflective sections.

28184 **(DOE/R7/01223—T1) Small active solar units for window installation. Summary and evaluation report.** (Educational Service Unit No. 9, Hastings, NE (USA)). 1984. Contract FG47-81R701223. 38p. NTIS, PC A03; 3; GPO Dep. Order Number DE84009763.

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The purpose of this project was to develop a small 4' x 8' active solar hot-air collector unit simple enough to be constructed by a sheltered workshop population of mentally retarded adults. Four units were constructed using rigid Sun-Lite for glazing. The design, construction, installation, and performance of these units are discussed in this report.

28185 **(DOE/R7/01234—T1) Mobil home solar collector.** Hoffman, S.A. (Hoffman (Scott A.), Columbia, MO (USA)). Aug 1983. Contract FG47-81R701234. 6p. NTIS, PC A02; 3; GPO Dep. Order Number DE84010452.

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The construction of a filon glazed collector on the south facing wall of a mobile home is described. The existing galvanized metal skin of the triler was used as the absorber.

28186 **(NP—4901229) Standards for solar energy devices in Arizona.** Williamson, R.T. (Arizona Solar Energy Commission, Phoenix (USA)). May 1983. 22p. Arizona Solar Energy Commission, Capital Tower, Room 502, 1700 West Washington St., Phoenix, AZ 85007. Order Number DE84901229.

This booklet explains the details of Arizona's program of standards for solar energy equipment. The Arizona Legislature directed the Arizona Solar Energy Commission to develop standards for solar energy devices as a prerequisite for the eligibility of those devices for Arizona's solar tax credits. Standards were adopted in 1980 and went into effect on January 1, 1982. This booklet is divided into three sections: in the first section the testing and rating standards for solar collectors are described. Most solar collectors sold in Arizona can be tested and rated under these standards. The second section describes the testing and rating of solar domestic hot water systems. System testing is only required for solar devices that can not be adequately tested by the standards described in the first section. However, any solar water heating system may be tested under the system standards. In the third section the certification programs of ARI and SRCC and Arizona's Listing are described.

28187 **(SAND—84-0632C) Solar thermal parabolic dish systems: technology and applications.** Leonard, J.A. (Sandia National Labs., Albuquerque, NM (USA)). May 1984. Contract AC04-76DP00789. 10p. (CONF-840804—15). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE84012239.

From Intersociety energy conversion engineering conference; San Francisco, CA, USA (19 Aug 1984).

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This presentation surveys the status and some probable future courses of development of parabolic dish solar collector technology and some of the near-term and long-range applications of the technology. Included are fundamentals of the technology, descriptions of current collectors with particular emphasis on the types developed within the Department of Energy's Solar Thermal Program, descriptions of current systems and applications, key technical issues and tradeoff considerations which will affect the competition between parabolic dish systems and other solar thermal technologies, and, finally, a discussion of future possibilities for the development of parabolic dish technology.

1420 Heat Storage

REFER ALSO TO CITATION(S) 28140, 28170, 28471

28188 (CONF-840410—1) Seasonal storage solar heating system for the Charlestown, Boston Navy Yard National Historic Park. Breger, D.S.; Michaels, A.I. (Argonne National Lab., IL (USA)). 30 Apr 1984. Contract W-31-109-ENG-38. 6p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE84009626.

From 1. European Communities conference on solar heating; Amsterdam, Netherlands (30 Apr 1984).

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This paper concerns the design and analysis of a solar energy system using seasonal heat storage for the National Historic Park in the Charlestown Navy Yard, Boston, Massachusetts. The system uses two existing underground concrete storage tanks filled with water as the heat store and makes use of an existing tunnel network for placement of the heat distribution pipe network. The system includes a heat pump and is designed to supply about 1000 MWH of solar heat to displace the hot water and space heat demand. The study is part of the US participation in the International Energy Agency Solar Heating ad Cooling Program, Task VII on Central Solar Heating Plants using Seasonal Storage. System analysis was performed using the MINSUN computer simulation model developed by this Task specifically for solar seasonal storage systems with district heating. Analytic results indicated a substantial performance improvement by incorporating a heat pump into the system to extend the useful storage temperature range and reduce the annual average system temperatures.

28189 (DOE/R7/01231—T1) Solar heat storage in phase change material. Phillips, H.J. (Creighton Univ., Omaha, NE (USA). School of Medicine). 28 Feb 1984. Contract FG47-81R701231. 17p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE84009678.

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The objective of this project was to develop a chemical heat storage system that had a phase change with release of latent heat at about 105°F. The primary reason this kind on system was sought was that heat storage capacity of commonly used storage systems do not match the heat collection capacity of open air collectors. In addition to the phase change three other factors were considered: the cost of the material, the amount of heat the system would hold per unit volume, and the rate at which the system released sensible and latent heat. One hundred nineteen tests were made on 32 systems. Only data on six of the more promising are presented. In the six systems, borax was used as the major component with other materials used as nucleating agents toraise the temperature of phase change.

28190 (SAND—83-7464) Thermochemical energy transport systems study. (Fox (Jerry V.) Consulting Service Co., Albuquerque, NM (USA)). Mar 1984. Contract AC04-76DP00789. 75p. NTIS, PC A04/MF A01; 1; GPO Dep. Order Number DE84011604.

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A review of the recent literature is coupled with contacts with researchers in the area of thermochemical energy transport and storage systems to provide a basis for selecting a system. Four systems - SO_3 dissociation, ammonia dissociation, steam methane reforming, and CO_2 methane reforming - were chosen for further study. Finally, a preliminary flow sheet is developed for a four 11-meter parabolic dish solar reactor system based on SO_3 dissociation for construction at Sandia National Laboratories. The system would produce approximately 260 kW(t). A description of operation and a cost estimate of $2 million is presented.

15 GEOTHERMAL ENERGY

1501 Resource Status And Assessment

REFER ALSO TO CITATION(S) 28560

1502 Geology And Hydrology Of Geothermal Systems

REFER ALSO TO CITATION(S) 28211

28191 (BMFT-FB-T—84-019) Investigation of mineral and thermomineral springs in the Eifel mountains regarding geothermal indications. Langguth, H.R.; Plum, H.; Kimmelmann, A.A.; Hollerbach, A.; Wolf, M.; Schulz, R. (Bundesministerium fuer Forschung und Technologie, Bonn (Germany, F.R.)). Jan 1984. 176p. (In German). NTIS (US Sales Only), PC A08/MF A01. Order Number DE84751595.

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In the East Eifel area, a local anomaly of SiO_2-content and Na/K-ratios was found in mineral waters emerging around the lake Laach. The diameter of the anomalous area is about 10 to 12 km. All results obtained from the chemical investigations indicate, that the observed chemical anomaly is caused by a local temperature anomaly in the lake Laach area. In the rest of the investigation area non considerable temperature anomalies were discovered. The calculation of geotemperatures was only possible in higher concentrated thermal waters with low CO_2 content. The calculated subsurface temperatures are in Aachen 125°C, in Chaudfontaine 30°C, in Bad Bertrich 70 to 75°C and in Strotzbuesch 60°C. Due to the geological situation a reasonably deep circulation of fluids is regarded as the reason for the observed geotemperatures.

28192 (DOE/ET/27014—T8) Low temperature geothermal resource evaluation of the Moses Lake-Ritzville-Connell area, Washington. Widness, S. (Washington State Univ., Pullman (USA). Dept. of Civil and Environmental Engineering). Nov 1983. Contract AC07-79ET27014. 28p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE84012505.

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The study area is located in portions of Adams, Grant, Lincoln, and Franklin counties of eastern Washington. The area is representative of a complex stratigraphic and geohydrologic system within the basalt flows of the Columbia River Basalt Group. Fluid temperature data were collected by three different agencies. The Geological Engineering Section (WSU) at Washington State University, runs a continuous fluid temperature (FT) log as part of a complete suite of geophysical logs. The US Geological Survey (USGS) runs a continuous fluid FT log in conjunction with caliper and natural-gamma logs. Southern Methodist University (SMU) and the Washington State Department of Natural Resources, Division of Geology and Earth Resources (DNR), have cooperated in gathering FT data. The DNR-SMU data were collected by taking temperature measurements at 5 m intervals. Bottom-hole temperatures (BHT) and bottom-hole depths (BHD) of selected wells in the study area are given. A technique developed by Biggane (1982) was used to determine the geothermal gradients within the area. A least squares linear regression analysis of the relationship between the BHT and BHD was used to determine the geothermal gradient of a given well data group (WDG).

28193 (DOE/ET/27014—T9) Geological and geothermal investigation of the lower Wind River valley, southwestern Washington Cascade Range. Berri, D.A.; Korosec, M.A. (Washington State Dept. of Natural Resources, Olympia (USA)). 1983. Contract AC07-79ET27014. 69p. NTIS, PC A04/MF A01; 1; GPO Dep. Order Number DE84012545.

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The detailed geology of the lower Wind River valley is presented with emphasis on those factors that bear significantly on development of a geothermal resource. The lower Wind River drainage consists primarily of the Ohanapecosh Formation, an Oligocene

unit that is recognized across the entire southern Washington Cascade Range. The formation is at least 300 m thick in the Wind River valley area. It consists largely of volcaniclastic sediments, with minor massive pyroclastic flows, volcanic breccias and lava flows. Low grade zeolite facies metamorphism during the Miocene led to formation of hydrothermal minerals in Ohanapecosh strata. Metamorphism probably occurred at less than 180°C.

28194 **(DOE/ET/28407—4) Thermal ground water flow systems in the thrust zone in southeastern Idaho.** Ralston, D.R. (Idaho Univ., Moscow (USA). Idaho Water and Energy Resources Research Inst.). May 1983. Contract AS07-77ET28407. 365p. NTIS, PC A16/MF A01; 1; GPO Dep. Order Number DE84011598.

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The results of a regional study of thermal and non-thermal ground water flow systems in the thrust zone of southern Idaho and western Wyoming are presented. The study involved hydrogeologic and hydrochemical data collection and interpretation. Particular emphasis was placed on analyzing the role that thrust zones play in controlling the movement of thermal and non-thermal fluids.

28195 **(DOE/ID/12057—T7) Lineaments of Texas - possible surface expressions of deep-seated phenomena. Final report.** Woodruff, C.M. Jr.; Caran, S.C. (Texas Univ., Austin (USA). Bureau of Economic Geology). Apr 1984. Contract AS07-79ID12057. 100p. NTIS, PC A05/MF A01; 1; GPO Dep. Order Number DE84010827.

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Lineaments were identified on 51 Landsat images covering Texas and parts of adjacent states in Mexico and the United States. A method of identifying lineaments was designed so that the findings would be consistent, uncomplicated, objective, and reproducible. Lineaments denoted on the Landsat images were traced onto 1:250,000-scale work maps and then rendered cartographically on maps representing each of the 51 Landsat images at a scale of 1:500,000. At this stage more than 31,000 lineaments were identified. It included significant areas outside of Texas. In preparing the final lineament map of Texas at 1:1,000,000-scale from the 1:500,000-scale maps, all features that lay outside Texas and repetition among features perceived by individual workers were eliminated. Cultural features were checked for before reducing and cartographically fitting the mosaic of 51 individual map sheets to a single map base. Lineaments that were partly colinear but with different end points were modified into a single lineament trace with the combined length of the two or more colinear lineaments. Each lineament was checked to determine its validity according to our definition. The features were edited again to eliminate processing artifacts within the image itself, as well as representations of cultural features (fencelines, roads, and the like) and geomorphic patterns unrelated to bedrock structure. Thus the more than 31,000 lineaments originally perceived were reduced to the approximately 15,000 presented on the 1:1,000,000 map. Interpretations of the lineaments are presented.

28196 **(DOE/ID/12079—95) Stratigraphy and structure of the McCoy geothermal prospect, Churchill and Lander Counties, Nevada.** Adams, M.C. (Utah Univ., Salt Lake City (USA). Earth Science Lab.). Jun 1982. Contract AC07-79ID12079. 90p. (ESL—112). NTIS, PC A05/MF A01; GPO Dep. Order Number DE84012192.

The McCoy geothermal system straddles the border of Lander and Churchill counties, central Nevada, in the middle of the Basin and Range Province. The study area occupies approximately 100 sq. km. near the intersection of the Augusta and Clan Alpine Mountains and the New Pass Range. The geology of the area is dominated by rhyolite ash-flow tuffs and subordinate intermediate-composition lava flows of Oligocene age. These volcanics were emplaced on Permo-Pennsylvanian massive cherts and Triassic dolomitic limestones. At least two episodes of hydrothermal activity can be recognized at McCoy. The oldest event altered and mineralized the volcanic and sedimentary rocks, producing the McCoy and Wild Horse mercury deposits. The youngest event produced travertine and siliceous sinter deposits which intercalate with alluvium, and appears to be related to the high heat flow found at the McCoy prospect. The oldest recognized faults at McCoy produced several east-west grabens and horsts. These fault zones were active before and during the deposition of the volcanics. The Wild Horse and McCoy mercury mines occur along one of these east-west fault zones. Basin and Range faulting began subsequent to 23 m.y. ago, and produced a complex array of polygonal blocks which were subsequently eroded into subparallel cuestas. Fluid movement in the geothermal system is controlled by the intersections of the east-west and north-south faults. There is no known igneous source for the thermal energy in this system. However, its intramontane location is atypical of known geothermal systems in the Basin and Range, which may preclude deep circulation through major basin-bounding faults.

28197 **(EUR—8540-EN) Investigation of the geothermal potential of the UK. The origin and circulation of groundwater in the Carnmenellis granite: the hydrogeochemical evidence.** Burgess, W.G.; Edmunds, W.M.; Kay, R.L.F.; Andrews, J.N.; Lee, D.J. (Commission of the European Communities, Luxembourg). 1984. 91p. NTIS, PC AE05/MF E05.

The Carnmenellis granite contains the only recorded thermal groundwater in granites in the United Kingdom; the high salinity of the discharge is also unusual. The present study demonstrates that the thermal waters have evolved by circulation of meteoric water to moderate depths (not much more than 1 km) within a granite with a uniformly high thermal gradient; at depth they have mixed with saline water of considerable age. The high salinities result from groundwater - granite reactions in parent strata of high chloride content.

28198 **(LA-UR—84-1181) Reservoir modeling of the Phase II Hot Dry Rock System.** Zyvoloski, G. (Los Alamos National Lab., NM (USA)). 1984. Contract W-7405-ENG-36. 5p. (CONF-840809—9). NTIS, PC A02; 3; GPO Dep. Order Number DE84011337.

From Geothermal Resources Council annual meeting; Reno, NV, USA (27 Aug 1984).

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The Phase II system has been created with a series of hydraulic fracturing experiments at the Fenton Hill Hot Dry Rock site. Experiment 2032, the largest of the fracturing operations, involved injecting 5.6 million gallons (21,200m^3) of water into wellbore EE-2 over the period December 6-9, 1983. The experiment has been modeled using geothermal simulator FEHM developed at Los Alamos National Laboratory. The modeling effort has produced strong evidence of a large highly fractured reservoir. Two long term heat extraction schemes for the reservoir are studied with the model.

28199 (NMERDI—2-69-2208, pp 165-183) **Geothermal resources of the Rio Grande rift.** Swanberg, C.A. (New Mexico State Univ., Las Cruces). Feb 1984. New Mexico Energy Research Development Institute Center, Univ. of New Mexico, 457 Washington, SE, Albuquerque, NM 87108. Order Number DE84900886. TI84900886

In Regional geothermal exploration in north central New Mexico. Final report.

The following aspects of the Rio Grande Rift are discussed: geologic setting, constriction-related geothermal resources; and geothermal resources of the Valles Caldera. (MHR)

1503 Geothermal Exploration And Exploration Technology

REFER ALSO TO CITATION(S) 28191, 28192

28200 **(DOE/ET/27014—T10) Preparation of residual gravity maps for the southern Cascade Mountains, Washington using Fourier analysis.** Dishberger, D.M. (Washington State Dept. of Natural Resources, Olympia (USA)). Apr 1983. Contract AC07-79ET27014. 79p. NTIS, PC A05/MF A01; 1; GPO Dep. Order Number DE84012546.

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A continuation of gravity work in the Cascade Mountains of Washington is presented. Baseline gravity data were collected for use in geothermal resource evaluation. The purpose of this report is to describe a Fourier analysis method for separating residual and regional gravity anomalies from a complete Bouguer gravity anomaly field. The technique has been applied to gravity data from the Southern Cascade Mountains, Washington. Residual gravity anomaly maps at a scale of 1:250,000 are presented for various regional wavelength filters, and a power spectrum of the frequency components in the South Cascade gravity data is displayed. No attempt is made to interpret the results of this study in terms of geologic structures.

28201 **(DOE/ET/27014—T11) Principal facts and a discussion of terrain correction methods for the complete Bouguer gravity anomaly map of the Cascade Mountains, Washington.** Danes, Z.F.; Phillips, W.M. (Washington State Dept. of Natural Resources, Olympia (USA)). Feb 1983. Contract AC07-79ET27014. 163p. NTIS, PC A08/MF A01; 1; GPO Dep. Order Number DE84012507.

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Since 1974, the Division of Geology and Earth Resources, in conjunction with the US Department of Energy, has supported gravity studies in the Cascade Mountains of Washington State. Results of the Cascade gravity project are summarized graphically as a complete Bouguer gravity anomaly map of the Cascade Mountains, Washington (Danes and Phillips, 1983). This report provides supplementary data and documentation for the complete Bouguer gravity anomaly map. Presented are principal gravity facts, simple Bouguer and Free-air gravity anomalies, computational methods, error analysis and a discussion of terrain corrections.

28202 **(DOE/ET/27014—T14) Fluid-temperature logs for selected wells in eastern Washington.** Stoffel, K.L.; Widness, S. (comps.). (Washington State Dept. of Natural Resources, Olympia (USA); Washington State Univ., Pullman (USA). Dept. of Civil and Environmental Engineering). Dec 1983. Contract AC07-79ET27014. 357p. NTIS, PC A16/MF A01; 1; GPO Dep. Order Number DE84012503.

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This Open-File Report consists of fluid temperature logs compiled during studies of the geohydrology and low temperature geothermal resources of eastern Washington. The fluid temperature logs are divided into two groups. Part A consists of wells which are concentrated in the Moses Lake-Ritzville-Connell area. Full geophysical log suites for many of these wells are presented in Stoffel and Widness (1983) and discussed in Widness (1983, 1984). Part B consists of wells outside of the Moses Lake-Ritzville-Connell study area.

28203 **(DOE/ET/27014—T15) Geophysical logs from water wells in the Yakima area, Washington.** Biggane, J.H. (Washington State Univ., Pullman (USA). Coll. of Engineering). 1983. Contract AC07-79ET27014. 139p. NTIS, PC A07/MF A01; 1; GPO Dep. Order Number DE84012506.

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The logs include: natural gamma, gamma gamma, neutron neutron, neutron gamma, caliper, fluid temperature, fluid resistivity, wall resistivity, spontaneous potential, and flow meter.

28204 **(DOE/ET/27014—T16) Geophysical logs of selected wells in eastern Washington.** Stoffel, K.L.; Widness, S. (Washington State Dept. of Natural Resources, Olympia (USA); Washington State Univ., Pullman (USA). Geological Engineering Section). Dec 1983. Contract AC07-79ET27014. 230p. NTIS, PC A11/MF A01; 1; GPO Dep. Order Number DE84012508.

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This report consists of geophysical well logs compiled during studies of the geohydrology and low temperature geothermal resources of eastern Washington. The geophysical logs are divided into two groups. Part A consists of wells concentrated in the Moses Lake-Ritzville-Connell area. Results of the geohydrologic study are discussed in Widness (1983, 1984). Part B consists of wells outside of the Moses Lake-Ritzville-Connell study area.

28205 **(DOE/ET/27205—T1) Inventory of geothermal resources in Nebraska. Final report.** Gosnold, W.D.; Eversoll, D.A. (Nebraska Univ., Lincoln (USA)). 30 Jun 1983. Contract AS07-79ET27205. 346p. NTIS, PC A15/MF A01; 1; GPO Dep. Order Number DE84009679.

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The goal of the State Coupled Resource Assessment Program is to identify and evaluate geothermal resources in the state, particularly low-temperature potential. Eight tasks were identified and documented in this report as follows: bottom-hole temperature survey, heat flow and temperature gradient survey, data translation studies, gravity data, substate regions, information dissemination, state geothermal map, and reports. The project had three major products: (1) a map, Geothermal Resources of Nebraska; (2) a significant amount of thermal data collected and documented within the state; and (3) a series of publications, presentations and meetings (documented as an Appendix).

28206 **(DOE/ET/28365—23) Geothermal resource assessment of Hot Sulphur Springs, Colorado.** Pearl, R.H.; Zacharakis, T.G.; Ringrose, C.D. (Colorado Geological Survey, Denver (USA)). 1982. Contract AS07-77ET28365. 56p. NTIS, PC A04/MF A01; 1; GPO Dep. Order Number DE84012500.

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Approximately 10 springs whose waters are used for recreation, steam baths and laundry purposes are located at Hot Sulphur Springs. Estimated heat-flow at Hot Sulphur Springs is approximately 100 mW/m2, which is about normal for western Colorado. Recent work tends to show that surface and reduced heat flow in the mountains of northern Colorado could be high. The thermal waters have an estimated discharge of 50 gpm, a temperature that ranges from 104°F (40°C) to a high of 111°F (44°C), and a total dissolved solid content of 1200 mg/l. The waters are a sodium bicarbonate type with a large concentration of sulphate. It is estimated that the most likely reservoir temperature of this system ranges from 167°F (75°F) to 302°F (150°C) and that the areal extent of the system could encompass 1.35 sq mi (3.50 sq km) and could contain 0.698 Q's (1015 B.T.U.'s) of heat energy. Soil mercury and electrical resistivity surveys were conducted. The geophysical survey delineated several areas of low resistivity associated with the north trending fault that passes just to the west of the spring area. It appears that this fault is saturated with thermal waters and may be the conduit along which the thermal waters are moving up from depth. The appendices to this report include tables showing water temperatures required for various industrial processes, as well as dissolved minerals, trace elements and radioactivity levels found in the thermal waters. Also presented are a complete description of the factors affecting the electrical resistivity measurements, a description of the electrical resistivity equipment used, and the resistivity field procedures. Electrical resistivity calculations are also included in the appendices.

28207 **(DOE/ID/12079—96) Detection of conductive bodies in a layered earth using the magnetotelluric method: application to silicic magma bodies.** Newman, G.A.; Wannamaker, P.E.; Hohmann, G.W. (Utah Univ., Salt Lake City (USA). Earth Science Lab.). Mar 1983. Contract AC07-79ID12079. 60p. (ESL—113). NTIS, PC A04/MF A01; GPO Dep. Order Number DE84012185.

This manuscript considers some of the factors that determine the detectability of three-dimensional (3-d) silicic magma bodies using the magnetotelluric (MT) method. Model simulations show that MT detection of magma depends strongly on its one-dimensional (1-d) host. Very subdued (3-d) responses of a juvenile magma body were observed for a theoretical Great Basin 1-D host. The attenuation of 3-D responses is caused by current channeling in layered media. Two factors are responsible for this. First, the scattering currents induced by the body are short circuited into the deep, less resistive crust, below 15 km. Second, the conductive overbur-

den in the top 2 km of the earth's crust further reduces the scattered electric fields that do reach the earth's surface. However, intermediate and mature magmatic systems may be detectable with the MT method. Diapiric uprise of magma may continue to the point where magma is no longer in contact with the lower less resistive crust. Further, the ascent and release of volatiles may lead to sufficient fracturing above the magma body so as to establish electrical contact with the shallow conductive crust. Thus a substantial MT response due to current channeling in the shallow crust may occur.

28208 **(DOE/ID/12079—97) Controlled source electromagnetic methods in geothermal exploration.** Ward, S.H. (Utah Univ., Salt Lake City (USA). Earth Science Lab.). Apr 1983. Contract AC07-79ID12079. 52p. (ESL—114). NTIS, PC A04/MF A01; 1; GPO Dep. Order Number DE84012184.

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The objective of this manuscript is to sketch the problems inherent in application of controlled source electromagnetic methods (CSEM) to geothermal exploration. Measurements have been made in both the time and frequency domains with time domain measurements currently enjoying an advantage over frequency domain measurements for shallow applications. Application of CSEM methods is impeded by natural field, electrification, geological, cultural, and topographic noise. Lateral resolution of parameters of adjacent steeply dipping bodies and vertical resolution of parameters of adjacent beds in a flatly dipping sequence are concerns with any CSEM method. Current channeling into a localized good conductor form a surrounding, overlying, or underlying conductor poses problems for the interpreter. In selecting a transmitter-receiver configuration for CSEM in a particular application, a compromise is usually achieved between such factors as domain of data acquisition, rejection of noise, resolution, current channeling, and depth of exploration. Not surprisingly there is only marginal agreement on the optimum selection of each of these variables. However, one of the more promising techniques for application in geothermal exploration is the controlled source audiomagnetotelluric method (CSAMT).

28209 **(DOE/ID/12079—104) Resistivity measurements before and after injection Test 5 at Raft River KGRA, Idaho. Final report.** Sill, W.R. (Utah Univ., Salt Lake City (USA). Earth Science Lab.). Sep 1983. Contract AC07-79ID12079. 18p. (ESL—121). NTIS, PC A02/MF A01; GPO Dep. Order Number DE84012186.

Resistivity measurements were made prior to, and after an injection test at Raft River KGRA, Idaho. The objectives of the resistivity measurements were to determine if measureable changes could be observed and whether they could be used to infer the direction of fluid flow. Most of the apparent resistivity changes observed after the injection phase of Test 5 are smaller than the estimated standard deviation of the measurements. However, the contour map of the changes suggest an anomalous trend to the northeast which is similar to the trend in the self-potential data. The numerical modeling of the resistivity data is marginal for changes as small as those observed but the results suggest that changes of a few percent could be expected from a fracture zone extending from depth to within 100 m of the surface.

28210 **(DOE/ID/12079—107) Water geochemistry of hydrothermal systems, Wood River District, Idaho.** Zeisloft, J.; Foley, D.; Blackett, R. (Utah Univ., Salt Lake City (USA). Earth Science Lab.). Aug 1983. Contract AC07-79ID12079. 24p. NTIS, PC A02/MF A01; GPO Dep. Order Number DE84012190.

Hydrothermal systems of the Wood River District, central Idaho, have been studied by geologic mapping of thermal spring areas and geochemical investigations of thermal and non-thermal waters. This report summarizes the new geochemical data gathered during the study. Integration of the results of geological and geochemical studies has led to development of a target model for hydrothermal resources on the margin of the Idaho Batholith. Warfield Hot Springs, with temperatures up to 58°C, flow from a major shear zone along the margin of an apophysis of the batholith. Hailey Hot Springs, with temperatures up to 60°C, occur in an area of multiple thrust faults and newly recognized, closely spaced normal faults in the Paleozoic Milligen and Wood River Formations, 2.5 km from a highly brecciated batholith contact. Other Wood River district hydrothermal systems also occur along the margins of batholith apophyses or in adjacent highly fractured Paleozoic rocks, where there are indications of batholith rocks at shallow depths (100 to 300 m) in water wells.

28211 **(DOE/NV/10081—1) Sweet lake geopressured-geothermal project Magma Gulf-Technadril/DOE Amoco Fee. Annual report, December 1, 1979-February 27, 1981. Volume I. Drilling and completion test well and disposal well.** Rodgers, R.W. (ed.). (Magma Gulf/Technadril, Houston, TX (USA)). Jun 1982. Contract AC08-80NV10081. 365p. NTIS, PC A16/MF A01; 1; GPO Dep. Order Number DE84010540.

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The Sweet lake site is located approximately 15 miles southeast of Lake Charles in Cameron Parish, Louisiana. A geological study showed that the major structure in this area is a graben. The dip of the beds is northwesterly into the basin. A well drilled into the deep basin would find the target sand below 18,000′, at high pressures and temperatures. However, since there is no well control in the basin, the specific site was chosen on the 15,000′ contour of the target sand in the eastern, more narrow part of the garben. Those key control wells are present within one mile of the test well. The information acquired by drilling the test well confirmed the earlier geologic study. The target sand was reached at 15,065′, had a porosity of over 20% and a permeability to water of 300 md. The original reservoir pressure was 12,060 psi and the bottom hole temperature 299°F. There are approximately 250 net feet of sand available for the perforation. The disposal well was drilled to a total depth of 7440′.

28212 **(DOE/RA/50075—1) Geochemistry, age and strontium isotope composition of late tertiary and quaternary basalts and andesites in western Nevada and their relation to geothermal potential. Final report, October 1, 1982-December 31, 1983.** Fultz, L.A.; Bell, E.J.; Trexler, D.T. (Nevada Univ., Reno (USA). Div. of Earth Sciences). Jan 1984. Contract FC03-80RA50075. 182p. NTIS, PC A09/MF A01; 1; GPO Dep. Order Number DE84012404.

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This research was undertaken to characterize the late Cenozoic volcanic rocks associated with active geothermal systems in west-central Nevada. Petrographic and microprobe, geochemical and isotopic analysis and age dating techniques were used to characterize these young volcanic rocks. These data were combined with the limited data previously reported in the literature on these same volcanic areas to interpret their petrogenesis. The overall characterization resulted from integrating the petrogenesis with a structural-tectonic model of the region. Potassium-argon isotopic ages ranging up to 14 million years were determined for eight localities within the Reno 1 x 2° study region. These ages are consistent with the morphology of the volcanic landforms, the active geothermal systems associated with them, and with other isotopic ages reported in the literature for these and similar rocks within the study region. Petrographic analysis of hand specimens and thin-sections indicated mineralogic assemblages of the respective rock types and specific mineral textures and phenocryst compositions and characteristics. These identifications were further substantiated by microprobe analysis of selected phenocrysts and groundmass phases. Classification of the respective rock types was also based on chemical composition and normative calculations using the program PETCAL. Basaltic andesites are identified and described for Steamboat Hills, Table Mountain, Silver Springs, Churchill Butte, Cleaver Peak, Desert Peak and Carson City sites.

28213 **(DOE/RA/50075—2) Geologic and hydrologic research on the Moana geothermal system, Washoe County, Nevada. Final report October 1, 1982-December 31, 1983.** Flynn, T.; Ghusn, G. Jr. (Nevada Univ., Reno (USA). Div. of Earth Sciences). Jan 1984. Contract FC03-80RA50075. 164p. NTIS, PC A08/MF A01; 1; GPO Dep. Order Number DE84012409.

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Combined geologic, geophysical, geochemical, and drilling exploration surveys were used to assess the Moana geothermal resource in Washoe County, Nevada, and to determine its relationship with nearby Steamboat Hot Springs. Moana is the largest single moderate-temperature resource in Nevada that supports geothermal space heating applications. Results show that the general geology and structure for the two systems is similar, but important differences exist with respect to reservoir rocks. Gravity data delineated the contact between important volcanic and sedimentary rocks in Moana, but contour trends did not correlate well with mapped faults. Fluid geochemistry data show major differences in bulk chemical composition, stable-light isotope ratios, and radiocarbon ages for Moana and Steamboat geothermal waters. Water level measurements in observation wells in Moana show simultaneous increasing and decreasing values in different sections of the geothermal area. Temperature-depth profiles changed little during the six-month monitoring period. Direct use of the resource is increasing and longer-lasting, more efficient down-hole heat exchangers are replacing previous equipment that was prone to scaling and corrosion. A computer program that calculates heat output for state-of-the-art heat exchangers is described. Recommendations for continued monitoring, heat exchanger design, and fluid reinjection studies are included. Data are available to government agencies responsible for regulation as well as local residents and potential developers to ensure prudent resource utilization.

28214 **(LA-UR—84-1208) Hydrogeochemistry of the Qualibou Caldera Geothermal System, St. Lucia, West Indies.** Goff, F.; Vuataz, F.D. (Los Alamos National Lab., NM (USA)). 1984. Contract W-7405-ENG-36. 8p. (CONF-840809—8). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE84011372.

From Geothermal Resources Council annual meeting; Reno, NV, USA (27 Aug 1984).

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Interpretation of hydrogeochemical data and supporting geologic and electric resistivity data have been used to define the basic structure of the Qualibou Caldera geothermal system and propose a model of hydrologic flow. The geothermal system at Sulphur Springs consists of three layers: (1) an upper steam condensate zone; (2) an intermediate vapor zone, which may be restricted to the Sulphur Springs area only; and (3) a lower brine zone. Four lines of evidence suggest that temperatures of the brine layer may exceed 230°C at depths of perhaps 1 km. Outlying thermal springs along the northwest side of the caldera do not indicate derivation from underlying high-temperature sources. It is suggested that the main reservoir upflows in the Belfond-Sulphur Springs area and flows laterally in the subsurface toward the northwest caldera wall.

28215 **(LBL—17716) Proposed scientific activities for the Salton Sea Scientific Drilling Project.** (Lawrence Berkeley Lab., CA (USA)). May 1984. Contract AC03-76SF00098. 140p. NTIS, PC A07/MF A01; 1; GPO Dep. Order Number DE84012256.

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The Salton Sea Scientific Drilling Project (SSSDP) has been organized for the purpose of investigating a hydrothermal system at depths and temperatures greater than has been done before. Plans are to deepen an existing well or to drill a new well for research purposes for which temperatures of 300°C will be reached at a depth of less than 3.7 km and then deepen that well a further 1.8 km. This report recounts the Congressional history of the appropriation to drill the hole and other history through March 1984, gives a review of the literature on the Salton Sea Geothermal Field and its relationship to other geothermal systems of the Salton Trough, and describes a comprehensive series of investigations that have been proposed either in the well or in conjunction with the SSSDP. Investigations in geophysics, geochemistry and petrology, tectonics and rock mechanics, and geohydrology are given. A tabulation is given of current commercial and state-of-the-art downhole tools and their pressure, temperature, and minimum hole size limitations.

28216 **(NMERDI—2-69-2208) Regional geothermal exploration in north central New Mexico. Final report.** Icerman, L. (ed.). (New Mexico State Univ., Las Cruces (USA). New Mexico Energy Inst.). Feb 1984. 274p. New Mexico Energy Research Development Institute Center, Univ. of New Mexico, 457 Washington, SE, Albuquerque, NM 87108. Order Number DE84900886.

A broad-based geothermal resource reconnaissance study covering Bernalillo, Los Alamos, Rio Arriba, San Miguel, Sandoval, Santa Fe, Taos, Torrance, and Valencia counties in north central New Mexico was conducted from June 15, 1981, through September 30, 1983. Specific activities included the compilation of actual temperature, bottom-hole temperature gradient, and geotemperature data; tabulation of water chemistry data; field collection of temperature-depth data from existing wells; and drilling of temperature gradient holes in the Ojo Caliente, San Ysidro, Rio Puerco, and Polvadera areas. The data collected were used to perform: (1) a regional analysis of the geothermal energy potential of north central New Mexico; (2) two site-specific studies of the potential relationship between groundwater constrictions and geothermal resources; (3) an evaluation of the geothermal energy potential at Santa Ana Pueblo; (4) a general analysis of the geothermal energy resources of the Rio Grande Rift, including specific data on the Valles Caldera; and (5) an evaluation of the use of geothermometers on New Mexico groundwaters. Separate abstracts were prepared for individual chapters.

28217 (NMERDI—2-69-2208, pp 3-44) **Analysis of the geothermal energy potential of north central New Mexico.** Lohse, R.L. (New Mexico State University Energy Inst., Las Cruces). Feb 1984. New Mexico Energy Research Development Institute Center, Univ. of New Mexico, 457 Washington, SE, Albuquerque, NM 87108. Order Number DE84900886. TI84900886

In Regional geothermal exploration in north central New Mexico. Final report.

An analysis of temperature and geotemperature data from numerous sites throughout north central New Mexico results in several important observations. Actual temperature and bottom-hole temperature gradient data both suggest that two separate thermal regimes characterize the background temperatures in the upper crust within the study area. This result is suggested by the fact that there is almost a total absence of actual temperatures less than 15°C within the crust in the southwest portion of the study area.

28218 (NMERDI—2-69-2208, pp 45-113) **Measured geothermal gradients in north central New Mexico.** Hunter, J.C. (Los Alamos National Lab., NM). Feb 1984. New Mexico Energy Research Development Institute Center, Univ. of New Mexico, 457 Washington, SE, Albuquerque, NM 87108. Order Number DE84900886. TI84900886

In Regional geothermal exploration in north central New Mexico. Final report.

This study was initiated to collect and integrate data on geothermal gradients in north central New Mexico and to identify areas with characteristics favorable for the development of low-temperature geothermal resources. Temperature gradients were measured in 22 water wells and potentially favorable areas for geothermal resource development were identified at Santa Ana Pueblo, Ojo Caliente, La Cueva, and Taos.

28219 (NMERDI—2-69-2208, pp 114-148) **Temperature gradient studies near two groundwater constrictions in northern New Mexico.** Swanberg, C.A. (New Mexico State Univ., Las Cruces). Feb 1984. New Mexico Energy Research Development Institute Center, Univ. of New Mexico, 457 Washington, SE, Albuquerque, NM 87108. Order Number DE84900886. TI84900886

In Regional geothermal exploration in north central New Mexico. Final report.

The Embudo and La Bajada constrictions are two groundwater constrictions located in north central New Mexico. Groundwater constriction theory suggests that both should be associated with geothermal resources yet no geothermal discoveries have been made, quite likely due to the lack of data and/or the lack of a suitable geothermal investigation. The purpose of the present investiga-

tion was to locate and thermally log all available wells near these two constrictions and to supplement these data with temperature-depth data (taken from oil, gas, and water wells), geochemical data, and any other appropriate data in order to make a geothermal evaluation of the two groundwater constrictions.

28220 (NMERDI—2-69-2208, pp 149-164) **Thermal data for springs and wells.** Swanberg, C.A. (New Mexico State Univ., Las Cruces). Feb 1984. New Mexico Energy Research Development Institute Center, Univ. of New Mexico, 457 Washington, SE, Albuquerque, NM 87108. Order Number DE84900886. TI84900886

In Regional geothermal exploration in north central New Mexico. Final report.

This chapter consists of thermal and dissolved silica content data for springs and shallow groundwater wells. The data have been compiled from the USGS water quality file (WATSTORE) but have not been field checked and may contain errors. The data of Shearer and Reiter (1978), and field measurements obtained as part of this study are indicated on a map of north central New Mexico.

28221 (NMERDI—2-69-2208, pp 184-188) **Geochemical data representing thermal and nonthermal waters from the Valles Caldera.** Swanberg, C.A. (New Mexico State Univ., Las Cruces). Feb 1984. New Mexico Energy Research Development Institute Center, Univ. of New Mexico, 457 Washington, SE, Albuquerque, NM 87108. Order Number DE84900886. TI84900886

In Regional geothermal exploration in north central New Mexico. Final report.

This chapter contains a detailed study of the geochemistry from the Valles Caldera area, which is the only known high-temperature (e.g., > 150°C) geothermal resource area in New Mexico. The geochemical data were compiled from Goff et al. (1981), Goff et al. (1982), and Summers (1976) and are reported as follows: isotope and chemical geothermometry data for the Valles Caldera and groundwater chemistry for the Valles Caldera. Actual temperatures, Na-K-Ca and SiO_2 (quartz) geotemperatures, and oxygen and deuterium isotope data for 55 sites are summarized. Simplified geology of the Valles Caldera and groundwater chemistry for the 55 sites are shown. The water chemistry data are shown in the form of stiff (chemical) diagrams.

28222 (NMERDI—2-69-2208, pp 208-263) **Temperature gradient drilling in north central New Mexico.** Lohse, R.L.; Gross, J.T. (New Mexico State Univ., Las Cruces). Feb 1984. New Mexico Energy Research Development Institute Center, Univ. of New Mexico, 457 Washington, SE, Albuquerque, NM 87108. Order Number DE84900886. TI84900886

In Regional geothermal exploration in north central New Mexico. Final report.

A shallow temperature gradient hole drilling program was conducted in an effort to gain additional information about the possible size and controlling trends of probable geothermal resource areas in north central New Mexico. Twelve shallow temperature gradient holes were drilled in four distinct areas located within the study area. The areas to be drilled were selected on the basis of the results of the geothermal resource assessment of north central New Mexico described in Chapter 1. An attempt was made to site the holes in each area in the locations that appeared most favorable according to existing geological and geophysical data.

28223 (SAND—83-2413C) **Geoscience experiments in boreholes: instrumentation.** Traeger, R.K. (Sandia National Labs., Albuquerque, NM (USA)). May 1984. Contract AC04-76DP00789. 36p. (CONF-840572—1). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE84012241.

From International symposium on observation of the continental crust through drilling; Tarrytown, NY, USA (20 May 1984).

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Drilling is the only method available to obtain unambiguous information on processes occurring in the earth's crust. When core and virgin formation fluid samples are available, the geological state of the formation may be defined in the vicinity of the borehole with little ambiguity. Unfortunately, core recovery is expensive and often not complete, and drilling muds contaminate formation fluids. Thus, investigations turn to downhole instrumentation systems to evaluate in situ formation parameters. Some such instruments and the associated interpretative techniques are well developed, especially if they find usage in the evaluation of hydrocarbon reservoirs. Other sytems, particularly those that yield geochemical information are, at best, shallow-hole devices, but they could be engineered for deep-hole applications. Interpretations of logs obtained in igneous and metamorphic systems are not well developed. Finally, measurements away from the immediate vicinity of the borehole are possible but the technology is primitive. In situ instrumentation capabilities and needs for research in boreholes will be reviewed; the review will include details from recent US and European discussions of instrumentation needs. The capability and availability of slim hole logging tools will be summarized. Temperature limitations of the overall logging system will be discussed (current limits are 300°C) and options for measurements to 500°C will be described.

28224 (USGS-OFR—83-233) **Inversion results of time-domain electromagnetic soundings near Medicine Lake, California, geothermal area.** Anderson, W.L.; Frischknecht, F.C.; Raab, P.V.; Bradley, J.A.; Turnross, J.; Buckley, T.W. (Geological Survey, Denver, CO (USA)). 1983. 31p. US Geological Survey-Open File Service, Box 25425 Denver Federal Center, Denver, CO 80225. Order Number DE84901201.

A number of time-domain electromagnetic (TDEM) soundings were made in the vicinity of Medicine Lake, California, during July, 1982, as part of the US Geological Survey's geothermal research program. The objectives were to evaluate the use of TDEM methods in this environment, to compare frequency and time-domain results, and to study variations in the conductive layer (Zohdy and Bisdorf, 1982) which were known to exist in the area of the Medicine Lake volcano. The TDEM soundings were made at nine sites using both single and central loop configurations (Spies, 1980). At several of the sites, the large TDEM square loop (1500 ft. per side) was also used as a transmitter loop for loop-loop frequency domain soundings (Frischknecht, 1967). The frequency domain soundings have not been processed to-date; however, to make the data available, all TDEM results and their computer inversions are being presented in this preliminary report.

28225 (USGS-OFR—83-476) **Thermal data from well GD-1, Gibson dome, Paradox Valley, Utah.** Sass, J.H.; Lachenbruch, A.H.; Smith, E.P. (Geological Survey, Menlo Park, CA (USA)). 1983. 15p. NTIS, PC A02/MF A01. Order Number DE84900997.

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Temperature data were obtained to a depth of ~ 1900 m (6300 ft) in well GD-1, W. longitude 109° 36.9', N. latitude 38° 09.8', elevation 1503 m at Gibson Dome in the Paradox Basin, southeastern Utah. Thermal conductivities were measured on 15 specimens representative of the major formations. With the possible exception of some minor perturbations within the Molas and Leadville Limestone formations near the bottom of the well, no evidence exists for vertical water movement with seepage velocities exceeding a few mm y^{-1} within the well or formation.

1509 Geothermal Engineering

REFER ALSO TO CITATION(S) 28198

28226 (LA-UR—84-1182) **Insulating geothermal well casings from thermal stress with nitrogen gas or nitrogen foam.** Dreesen, D.S.; Murphy, H.D.; Zyvoloski, G.; McEligot, D.M.; Dash, Z.; Nicholson, R.N. (Los Alamos National Lab., NM (USA); Arizona Univ., Tucson (USA); Well Production Testing, Carlsbad, CA (USA)). 26 Aug 1984. Contract W-7405-ENG-36. 8p. (CONF-840809—11). NTIS, PC A02; 3; GPO Dep. Order Number DE84011338.

From Geothermal Resources Council annual meeting; Reno, NV, USA (27 Aug 1984).

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Fenton Hill Hot Dry Rock Geothermal Site Well EE-3 was designed and completed to function as a completion of the reservoirs with the injection well, EE-2, progressed it become evident that it would be desirable to fracture in EE-3 as well to obtain a flow connection between the wells. Unfortunately, the 9-5/8" od production casing in EE-3 had been pretensioned to 885,000 lbs to accommodate its intended service as a hot water production well. Cool-down of the casing was thus limited to only 11°C (20°F) to keep the stress in the top joints of the casing below the minimum yield stress, or else the pretension had to be released. Before incurring the risk and expense required to release the tension, fracturing experiments were performed to evaluate the use gaseous nitrogen and 75% quality nitrogen-gel foam as insulating media in an annular wellbore configuration, i.e., the nitrogen gas or foam was placed in the annular gap between the tubing string and the casing.

28227 **(LA-UR—84-1186) Using chemically reactive tracers to determine temperature characteristics of geothermal reservoirs.** Robinson, B.A.; Tester, J.W.; Brown, L.F. (Massachusetts Inst. of Tech., Cambridge (USA). Dept. of Chemical Engineering; Los Alamos National Lab., NM (USA)). 1984. Contract W-7405-ENG-36. 6p. (CONF-840809—10). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE84011373.

From Geothermal Resources Council annual meeting; Reno, NV, USA (27 Aug 1984).

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The rates of most chemical reactions are very sensitive to temperature, and this property can be used to measure temperature patterns in geothermal reservoirs. Two approaches are considered: reverse-flush and flow-through. Both of these can indicate thermal drawdown faster than the measurement of produced-fluid temperature. The reverse-flush approach is more difficult to carry out and interferes more with normal operation, but it gives the earlier indication of thermal drawdown and yields more information when using a single reaction. In both approaches, injecting a suite of reactants can yield bivariate time-temperature distributions which give temperature distributions as functions of fluid residence time. Applications to Hot Dry Rock systems are considered throughout the paper. Results of early kinetics studies of candidate tracer reactions also are reported.

28228 **(LA-UR—84-1192) Improvement of tubulars used for fracturing in hot dry rock wells.** Nicholson, R.W.; Dreesen, D.S.; Turner, W.C. (Well Production Testing, Carlsbad, CA (USA); Los Alamos National Lab., NM (USA)). Apr 1984. Contract W-7405-ENG-36. 9p. (CONF-840809—7). NTIS, PC A02; 3; GPO Dep. Order Number DE84011349.

From Geothermal Resources Council annual meeting; Reno, NV, USA (27 Aug 1984).

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Completion of hot dry rock wells as it is currently envisioned, requires that hydraulic fracturing be used to develop a heat extraction reservoir and to provide low impedance flow paths between the designated water injection and production wells. Recent fracturing operations at measured depths from 11,400 ft to 15,300 ft at the Fenton Hill Hot Dry Rock Geothermal Test Site have resulted in numerous failures of tubulars caused by the high fracturing pressures, corrosive environment and large treatment volumes at high flow rates. Two new fracturing strings were designed and purchased. Physical and chemical properties exceeding API specifications were demanded and supplied by the manufacturers. These tubulars have performed to design specifications.

28229 **(LA-UR—84-1194) Impact of fluid expansion and contraction on completion techniques for hot wells.** Dreesen, D.S.; Nicholson, R.W. (Los Alamos National Lab., NM (USA)). 1984. Contract W-7405-ENG-36. 7p. (CONF-840809—12). NTIS, PC A02/MF A01. Order Number DE84011351.

From Geothermal Resources Council annual meeting; Reno, NV, USA (27 Aug 1984).

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The thermal expansion and contraction of fluid with large changes in temperature can cause significant changes in (1) fluid displacement volumes, (2) pressure gradients in columns of fluid, (3) compressibility of the fluid, and (4) pressure in unported enclosures. In conjunction with the completion of Fenton Hill Hot Dry Rock (HDR) Wells EE-2 and EE-3 methods have been developed to calculate and compensate for expansion and contraction of wellbore fluids. These methods are outlined and specific operations where the methods were developed and used are described.

28230 **(SAND—84-0436) Suggested drilling research tasks for the Federal Government.** Carson, C.C. (Sandia National Labs., Albuquerque, NM (USA)). Apr 1984. Contract AC04-76DP00789. 69p. NTIS, PC A04/MF A01; 1; GPO Dep. Order Number DE84012919.

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A brief summary discussion of drilling, drilling research and the role of the government in drilling research is presented. Specific research and development areas recommended for federal consideration are listed. The technical nature of the identified tasks is emphasized. The Appendices present the factual basis for the discussion and recommendations. Numerous references are noted in the Appendices.

1510 Direct Energy Utilization

28231 **(DOE/ET/27055—10) Direct utilization of geothermal resources at Warm Springs State Hospital, Warm Springs, Montana. Final report, January 31, 1979-June 30, 1983.** (MultiTech, Inc., Butte, MT (USA)). Jan 1984. Contract FC07-79ET27055. 127p. NTIS, PC A07/MF A01; 1; GPO Dep. Order Number DE84011266.

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Several decades ago the water from a natural hot spring was piped to the Warm Springs State Hospital barn and greenhouse and eventually into the domestic water supply for showers. The Montana Department of Natural Resources and Conservation (DNRC) funded a feasibility study on potential development of the geothermal resource from monies originating from coal severence taxes. The results of the feasibility study were subsequently utilized in obtaining a $721,122 award from the Department of Energy Program Opportunity Notice (PON) program to identify and develop the geothermal resource at Warm Springs. The study included environmental and legal considerations, geophysical surveys, and the subsequent development of the resource. The well produces 60 to 64 gpm of 154°F geothermal water which is utilized in a heat exchanger to heat domestic water. The system became fully operational on January 13, 1983 and the calculated yearly energy savings represent approximately 17.6 million cubic feet of natural gas which is equivalent to $77,000, based on current prices.

1520 Geothermal Data And Theory

28232 (NMERDI—2-69-2208, pp 189-207) **Evaluation of the Na-K, Na-Li, K-Li, SiO_2 (Quartz), SiO_2 (Chalcedony), and Na-K-Ca geothermometers.** Swanberg, C.A. (New Mexico State Univ., Las Cruces). Feb 1984. New Mexico Energy Research Development Institute Center, Univ. of New Mexico, 457 Washington, SE, Albuquerque, NM 87108. Order Number DE84900886. TI84900886

In Regional geothermal exploration in north central New Mexico. Final report.

Three new geothermometers, namely, Na-K, K-Li, and Na-Li (Kharaha, 1981) were tested on thermal and nonthermal waters in New Mexico by computing correlations with the widely-accepted SiO_2 (quartz), SiO_2 (chalcedony), and Na-K-Ca geothermometers. Subsurface temperature estimates based on the new geothermometers were planned for use in the geothermal resources of New Mexico scientific map series (Swanberg, 1983) if the correlations warranted use of these new geochemical exploration tools.

16 Wave Energy Converters

REFER ALSO TO CITATION(S) 28134

17 WIND ENERGY

REFER ALSO TO CITATION(S) 28558

28233 (DOE/CS/69104—4) Bibliography: wind power. (Michigan Dept. of Commerce, Lansing (USA)). 1983. Contract FG45-80CS69104. 30p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE84010426.

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This bibliography consists of information sources, periodicals, and reference materials.

1701 Availability (climatology)

REFER ALSO TO CITATION(S) 28560

28234 (DOE/BP—211) Regional Wind Energy Assessment Program progress report, October 1982-September 1983. Baker, R.W.; Wade, J.E. (Oregon State Univ., Corvallis (USA). Dept. of Atmospheric Science). Feb 1984. 115p. (BPA—83-12). NTIS, PC A06/MF A01; 1; GPO Dep. Order Number DE84011832.

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The Bonneville Power Administration's (BPA) planning function requires that estimates be made of the magnitude, cost, and availability of all energy resources which may be available over a 20-year planning horizon. In order to assess the quantity, quality and location of wind energy resources in the Pacific Northwest, BPA commenced in 1980 a five year Regional Wind Energy Assessment Program through a contracting with the Oregon State University Wind Resource Assessment Laboratory. The program centers on wind prospecting, site instrumentation, data collection and analysis, and area verification in the BPA service area. The area covered in the study is extensive (over 250,000 sq. mi.) as it includes Washington, Oregon, Idaho, western Montana, and portions of northern Nevada and northern California. The topography is often complex and rugged and the wind characteristics (persistence and strength) can change dramatically in a short distance. Because of the spatial variability of the wind throughout the BPA service area, effort has been directed at instrumenting and analyzing data at sites throughout the service area. Over the past several years a large number of sites have been selected, instrumented and the data analyzed. During this time the methodology for site selection and our instrumentation strategy have evolved and at the same time analysis techniques have been refined.

28235 (DOE/BP—212) Regional Wind Energy Assessment Program progress report, October 1982-September 1983. Appendix. Wind statistics summaries. Baker, R.W.; Wade, J.E. (Oregon State Univ., Corvallis (USA). Dept. of Atmospheric Science). Feb 1984. 94p. (BPA—83-12-App.). NTIS, PC A05/MF A01; 1; GPO Dep. Order Number DE84011835.

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This report is made up of tables which show the Wind Speed Frequency Distribution Summaries of twenty-six different sites.

28236 (DOE/RL/01830—T16) United States average wind power by season. (Pacific Northwest Lab., Richland, WA (USA)). 1984. Contract AC06-76RL01830. 12p. NTIS, PC A02/MF A01; GPO Dep. Order Number DE84012214.

Map.

These wind resource maps are based on a synthesis of 12 regional assessments covering the United States and its territories. The four seasons are defined as: Winter-December, January, and February; Spring-March, April, and May; Summer-June, July, and August; Autumn-September, October, and November. A map of the annual average wind resource is also available. For each region, wind resource assessments are presented in the form of an atlas. The atlases depict in graphic, tabular, and narrative form the wind resource on a regional and state level.

28237 (DOE/RL/01830—T17) Worldwide energy resource distribution estimates. (Pacific Northwest Lab., Richland, WA (USA)). 1984. Contract AC06-76RL01830. 15p. NTIS, PC A02/MF A01; GPO Dep. Order Number DE84012216.

Map.

This map is a preliminary estimate of the annual mean wind energy available at typical well-exposed locations throughout the world. The average energy in the wind flowing in the layer near the ground is expressed as a wind energy class. The greater the average wind energy, the higher the wind energy class, and the darker the shade of blue on the map. The colors corresponding to classes of wind energy are defined in the table at the upper right.

1704 Economics

28238 (DOE/R7/01248—T1) Wind energy in southwest Missouri: economic potential of utilizing large wind energy conversion systems. Final report. Uffmann, S.W.; Ervin, D.E. (Missouri Univ., Columbia (USA). Dept. of Agricultural Economics). 1 Sep 1982. Contract FG47-81R701248. 153p. NTIS, PC A08/MF A01; 1; GPO Dep. Order Number DE84010432.

Portions are illegible in microfiche products.

Energy supply disruptions and price increases since 1974 have served to dramatically increase interest in alternative energy technologies. Wind energy, because of its past role and relative maturity, is now receiving increased study from the full spectrum of energy related disciplines. Although the present body of literature is quite extensive, there is a paucity of economic investigations. The general purpose of this study was to explore the economic feasibility of utilizing large wind energy conversion systems (WECS) by an established electric utility in southwest Missouri, Empire District Electric Company.

1706 Wind Energy Engineering

REFER ALSO TO CITATION(S) 29187

28239 (DOE/NASA—0337-1) Corrosion fatigue of high strength fastener materials in seawater. Final report. Tipton, D.G. (LaQue Center for Corrosion Technology, Inc., Wrightsville Beach, NC (USA)). Dec 1983. Contract AI01-76ET20320. 25p. (NASA/CR—174677). NTIS, PC A02/MF A01. Order Number DE84012274.

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Environmental effects can significantly reduce the fatigue life of metals. As such, corrosion fatigue is a major concern in the engineering application of high strength fasteners in marine environments. The corrosion fatigue failure of an AISI 41L40 high strength steel blade-to-hub attachment bolt at the MOD-0A 200 kW wind turbine generator in Oahu, Hawaii prompted the current test program. Tests were undertaken to confirm the dramatic reduction of fatigue strength of AISI 41L40 in marine environments and to obtain similar corrosion fatigue data for candidate replacement materials. AISI 41L40, AISI 4140, PH 13-8Mo stainless steel, alloy 718 and alloy MP-35N were tested in axial fatigue at a frequency of 20 Hz in dry air and natural seawater. The fatigue data were fitted by regression equations to allow determination of fatigue strength for a given number of cycles to failure.

28240 (DOE/NASA/20320—57) Mathematical model for the doubly-fed wound rotor generator. Part II. Brady, F.J. (National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center). 1984. Contract AI01-76ET20320. 6p. (CONF-840706—2; NASA-TM—83581). NTIS, PC A02/MF A01; GPO Dep. Order Number DE84006794.

From Power Engineering Society summer meeting; Seattle, WA, USA (15 Jul 1984).

This paper is a mathematical analysis of a doubly-fed wound rotor generator. It is a continuation of a previous paper, which applied the constraints of constant stator voltage and frequency to the circuit equations and obtained expressions for the currents and voltages in the machine. In this paper the previously derived variables are redefined as direct and quadrature components. In addition, the apparent (complex) power for both the rotor and the stator are derived in terms of these redefined components.

28241 **(EPRI-AP—3447) Wind turbine performance assessment. Technology status report No. 7. Final report.** Vachon, W.A. (Little (Arthur D.), Inc., Cambridge, MA (USA)). Apr 1984. 140p. EPRI-Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number DE84920337.

This report presents a summary of test data and experience from both federally and privately funded wind turbine (WT) development and test programs in the United States, Canada, and Europe. This report covers the period from May 1982 to October 1982 and features a section on foreign WT test programs. It also contains summaries of test results for the U.S. Department of Energy (DOE) cluster of three 2.5-MW MOD-2 horizontal-axis WT's. Descriptions of the DOE's two MOD-5 WT design concepts are also provided. The program of the U.S. Bureau of Reclamation has been updated with status reports on the two megawatt-scale (4 and 2.5 MW) wind turbines, both of which are operational. Recent results and experience from the WT tests privately funded by the Pacific Gas and Electric Company and the FloWing Corporation are also described. A summary of key Canadian and European WT programs is presented as well as an update on the test results from several key machines. Foreign WT programs are important because of a few activities aimed at the development of unique machine design features. In addition, these programs feature unique control approaches that are expected to lead to reduced operation and maintenance costs, and thus augment the test data base of programs in the United States.

28242 **(PNL—4888) Measurement of turbulent wind velocities using a rotating boom apparatus.** Sandborn, V.A.; Connell, J.R. (Pacific Northwest Lab., Richland, WA (USA); Colorado State Univ., Fort Collins (USA)). Apr 1984. Contract AC06-76RL01830. 76p. NTIS, PC A05/MF A01; 1; GPO Dep. Order Number DE84012417.

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The present report covers both the development of a rotating-boom facility and the evaluation of the spectral energy of the turbulence measured relative to the rotating boom. The rotating boom is composed of a helicopter blade driven through a pulley speed reducer by a variable speed motor. The boom is mounted on a semiportable tower that can be raised to provide various ratios of hub height to rotor diameter. The boom can be mounted to rotate in either the vertical or horizontal plane. Probes that measure the three components of turbulence can be mounted at any location along the radius of the boom. Special hot-film sensors measured two components of the turbulence at a point directly in front of the rotating blade. By using the probe rotated 90° about its axis, the third turbulent velocity component was measured. Evaluation of the spectral energy distributions for the three components of velocity indicates a large concentration of energy at the rotational frequency. At frequencies slightly below the rotational frequency, the spectral energy is greatly reduced over that measured for the nonrotating case measurements. Peaks in the energy at frequencies that are multiples of the rotation frequency were also observed. We conclude that the rotating boom apparatus is suitable and ready to be used in experiments for developing and testing sensors for rotational measurement of wind velocity from wind turbine rotors. It also can be used to accurately measure turbulent wind for testing theories of rotationally sampled wind velocity.

28243 **(PNL-SA—12081) Overview of wind turbine siting considerations.** Wendell, L.L. (Pacific Northwest Lab., Richland, WA (USA)). Mar 1984. Contract AC06-76RL01830. 11p. (CONF-840302—4). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE84011686.

From 11. annual energy technology conference and exposition; Washington, DC, USA (19 Mar 1984).

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The purpose of this overview presentation is to review and highlight primarily the meteorological siting considerations over a broad range of time and space scales and to address the issues where further research is needed. The discussion will proceed by using some recent work on the development of siting guidelines for the utility application of wind turbines as a vehicle for examining the issues. This work was initiated by the Electric Power Research Institute (EPRI) in 1982 and reported in 1983. The siting guidelines were given a trial application with two participating utilities.

28244 **Jet spoiler arrangement for wind turbine.** Cyrus, J.D.; Kadlec, E.G.; Klimas, P.C. (to Dept. of Energy). US Patent Application 6-532,430. 15 Sep 1983. 13p. Contract AC04-76DP00789.

An air jet spoiler arrangement is provided for a Darrieus-type vertical axis wind-powered turbine. Air is drawn into hollow turbine blades through air inlets at the end thereof and is ejected in the form of air jets through small holes or openings provided along the lengths of the blades. The air jets create flow separation at the surfaces of the turbine blades, thereby including stall conditions and reducing the output power. A feedback control unit senses the power output of the turbine and controls the amount of air drawn into the air inlets accordingly.

28245 **Model study of a wind turbine driven heat pump.** Gunkel, W.W.; Nattuvetty, V.; Keim, D.J.; Salomon, J. (Cornell Univ., Ithaca, NY). pp 124-130 of Wind energy expo '82 and national conference American Wind Energy Association. Nelson, V. (ed.). Washington, DC; American Wind Energy Association (1982). (CONF-821092—).

From National wind energy expo conference; Amarillo, TX, USA (25 Oct 1982).

Wind energy can be utilized to heat water directly by means of a heat pump system. In one method investigated, the compressor of a heat pump is mechanically driven from a wind turbine drive shaft. Considering a piston type compressor, the performance can be improved by using a multi-cylinder compressor with the capability of loading or unloading any of the cylinders at any time. An external control is used to load or unload the cylinders depending upon the wind velocity. Presented in this paper is the evaluation of such a system and its performance over a nine month period when connected to a Pinson C2E3 cycloturbine. A study of the effect of the number of cylinders of the compressor and the load of each cylinder is also presented. The total energy extracted over a period of nine months is compared with that obtained by a direct driven water-heating agitator system. Simulations, neglecting system dynamics were completed and results are presented. Considering this wind turbine-heat pump system, results show that the wind energy extracted by a three-cylinder compressor with loading and unloading features is relatively less than that obtained from an agitator fluid friction unit. The higher the number of cylinders, the greater is the amount of energy extracted from the wind. However, it is expected that the compressor/heat pump system in a typical dairy operation will generate much greater quantities of heat energy because it extracts heat energy from other sources such as milk. Such a system also provides refrigeration and cooling capabilities. The effect of the gear ratio between the wind turbine and the compressor is also presented. It is observed that for a given wind turbine and a compressor, there is an optimum gear ratio at which the system efficiency is maximum. 5 references.

28246 **Design and construction of a folding 60 ft. self supporting tower system.** Miller, R.E. (Xavier Univ., Cincinnati, OH); Miller, J.R. pp 119-123 of Wind energy expo '82 and national conference American Wind Energy Association. Nelson, V. (ed.). Washington, DC; American Wind Energy Association (1982). (CONF-821092—).

From National wind energy expo conference; Amarillo, TX, USA (25 Oct 1982).

A system has been designed and constructed which allows a 60 ft. self supporting tower to be raised and lowered by means of a manually operated winch. An overview of the structural analysis and design of the cable system, gin pole, hinges, and winch founda-

tion is given. The system has not only facilitated installation and maintenance but has also added considerably to the safety of these tasks.

28247 **High wind loading of parked SWECS rotors: preliminary data.** Eckerman, G.J.; Wright, A.D.; Hodgkin, J.P. pp 131-136 of Wind energy expo '82 and national conference American Wind Energy Association. Nelson, V. (ed.). Washington, DC; American Wind Energy Association (1982). (CONF-821092—).

From National wind energy expo conference; Amarillo, TX, USA (25 Oct 1982).

Loads induced in parked (braked, feathered, furled or stalled) rotors during extreme wind events are a common source of SWECS failures, and among the preeminent design drivers. Analytical models for prediction of parked rotor survival loads have been developed at the US Department of Energy Wind Energy Research Center at Rocky Flats. Rotor response is modeled on two levels: a simple static blade/steady wind model, and a dynamic finite element model with transient gust inputs. Data have been collected on two SWECS during high wind shutdown operation and compared with predicted responses. Analytical loads models, data collection and analysis procedures, and preliminary results fo the study are presented herein. Recommendations for further model development are also presented. 8 references.

28248 **Method-of-bins update.** Akins, R.E. (Sandia National Lab., Albuquerque, NM). pp 146-151 of Wind energy expo '82 and national conference American Wind Energy Association. Nelson, V. (ed.). Washington, DC; American Wind Energy Association (1982). (CONF-821092—). Contract AC04-76DP00789.

From National wind energy expo conference; Amarillo, TX, USA (25 Oct 1982).

Techniques have been developed to augment the method-of-bins used to determine the output of a wind turbine in a field environment. Time-averaging of both wind-speed and output power before using the method-of-bins allows a greater separation between the reference anemometer and wind turbine and reduces uncertainties in the interpretation of the final results. Selective combining of records taken at different times and for different ranges of windspeeds may also be used to improve the reliability of the final data. 6 references.

28249 **Adopt an anemometer: a unique anemometer loan program.** Gipe, P. pp 79 of Wind energy expo '82 and national conference American Wind Energy Association. Nelson, V. (ed.). Washington, DC; American Wind Energy Association (1982). (CONF-821092—).

From National wind energy expo conference; Amarillo, TX, USA (25 Oct 1982).

A program is described in which the Center for Alternative Resources loaned 20 anemometers to public interest and civic organizations in Pennsylvania. The objectives of the program were to use the anamometers as a catalyst for disseminating information on wind energy, and to acquire data on wind speeds in uncharted areas of the state. The participants collected data from the anemometers weekly. Concurrently, the Center sought data from 6 airports within the region. The data from these two sources were then correlated: by using a graphical method for a qualitative comparison and by linear regression analysis for a quantitative comparison. An analysis of the data identified several areas of the state with good wind energy potential.

20 ELECTRIC POWER ENGINEERING

REFER ALSO TO CITATION(S) 28551

2001 Power Plants And Power Generation

REFER ALSO TO CITATION(S) 27770, 27771, 28549, 28683

28250 **(CONF-840456—1) Economics of industrial steam options for the 1980's.** Klepper, O.H. (Oak Ridge National Lab., TN (USA)). 1984. Contract AC05-84OR21400. 31p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE84011461.

From 6. annual symposium on industrial coal utilization; Pittsburgh, PA, USA (9 Apr 1984).

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The purpose of this study has been to answer two questions. First, how will stricter emission standards affect the cost of industrial steam systems, and secondly, how do the various systems stack up economically under various emission scenarios? We have found the answer to both of these questions and some other interesting results. A decrease in the allowed particulate release from a new industrial steam system seems to have little effect on the cost of steam. For small plants the cost of particulate control will significantly affect the cost of steam and therefore the acceptance of coal in this market. There are some strong conclusions that can be made about the relative cost of the various systems studied. On-site gasification is clearly uneconomic relative to direct coal firing for the boiler sizes considered. For low-sulfur, sub-bituminous coal applications, the AFBC has a significant advantage over conventional large boilers. For high-sulfur, bituminous coal, AFBC and conventional steam systems show nearly identical steam costs. In every region investigated, the steam from new coal-fired boilers is more expensive than from oil for small size systems. The implication is that research and development should focus on developing small low cost direct combustion coal systems. If these units were to become competitive with oil-fired boilers, they might displace the one-third of the new boiler market where oil/gas is the economic choice among the industrial steam options considered in this study. For the case where new coal-fired systems are compared to existing oil/gas-fired systems (which represent the largest fraction of installed industrial boiler capacity, but which were not specifically investigated in this study), the cost comparison would show oil more attractive even in medium size systems, strengthening this conclusion.

28251 **(DOE/ET/29033—T1) Large scale system effectiveness analysis. Final technical report, September 1977-February 1981.** Dersin, P.; Levis, A.H. (Systems Control, Inc., Burlington, MA (USA); Massachusetts Inst. of Tech., Cambridge (USA). Lab. for Information and Decision Systems). Feb 1981. Contract AC01-77ET29033. 156p. NTIS, PC A08/MF A01; 1; GPO Dep. Order Number DE84011275.

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A methodology for large scale system effectiveness analysis with application to electric power systems is presented. Three component attributes of effectiveness are introduced: sufficiency, efficiency, and equitability. In order to carry out comparisons, the power system is divided into the supply part consisting of generation, transmission, subtransmission, and the demand part, consisting of the end-users and the primary and secondary distribution systems. The feasibility set is introduced to characterize the supply system. The concept is generalized by admitting probabilistic behavior of the system components; this leads to the random feasibility set. The feasibility set and its properties are analyzed on the basis of the DC model. The transportation flow model is also used and the relationship between the two feasibility sets is established. Procedures for reducing the number of linear constraints that describe the set as a convex polyhedron in the space of loads are developed. The problem of dimensionality motivates the introduction of an aggregation procedure that is based on a continuum viewpoint; a partial differential equation analog to the DC model is derived.

28252 (EPRI-CS—3428) Acoustic emissions from crack growth in steam turbine rotor steels. Final report. Harris, D.O.; Dedhia, D.D.; Mamaros, T.C. (Science Applications, Inc., Sunnyvale, CA (USA)). Mar 1984. 359p. EPRI-RRC, Box 50490, Palo Alto, CA 94303. Order Number DE84920316.

This report provides the results of an experimental characterization of the acoustic emission resulting from fatigue crack growth in steam turbine rotor steels. Such result provides guidance in the development of on-line acoustic emission monitoring techniques for crack growth in rotors. Additionally, the results provide the first steps toward an ability to quantitatively relate acoustic emission to crack extension in rotors. Experiments were performed on specimens fabricated from a retired rotor in which cracks were grown under well-controlled laboratory conditions while simultaneously monitoring for acoustic emission. This allowed quantitative empirical relations to be drawn between acoustic emission and fracture mechanics parameters. Such relations are well suited for extrapolation to operating turbine rotors. It was found that the best correlation between acoustic emission and fracture mechanics parameters was between the number of acoustic emission events per cycle and the strain energy released by crack extension per cycle. The acoustic emission was not strongly influenced by the location of the specimen from the rotor, or the test temperature (within the range of 21 to 121°C), and the major source of acoustic emission was apparently the cracking of inclusions. The empirical acoustic emission-fracture mechanics relations were combined with a fracture mechanics analysis of fatigue crack growth in an operating turbine in order to estimate the number of acoustic emission events observable as a cracked rotor approached failure. It was predicted that 17 to 260 events would be observed during the 500 cold starts considered as leading to failure. This small number of events indicates that care must be used in the development of on-line monitoring instrumentation. Such information serves as a valuable input to future efforts to conceptualize and develop an on-line acoustic emission instrumentation system for steam turbine rotors.

28253 (TVA/PUB—84/37) Coal-fired plants project retirement plan. Bashambu, R.L. (Tennessee Valley Authority, Chattanooga (USA). Office of Power). Dec 1983. 132p. NTIS, PC A07/MF A01. Order Number DE84901242.

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TVA is committed to meet power demands on its system, and ensure availability of reliable power to its consumers at the lowest feasible cost. As a result of aging of equipment and other components, the cost of operating and maintaining the unit increases significantly. Also, age and use related problems in turbine, boiler, and electrical components could require costly replacements for continued safe operation of the plant. Therefore, studies must be done to determine if and when safe operating conditions do not exist any more, and further modifications and replacement of the plant equipment is considered uneconomical. Detailed evaluation of the major factors which impact operating conditions or contribute to the higher costs of generating power is necessary to determine whether it is economical to mothball, retire, or replace an existing generating unit with a new unit before it has become unsafe. There are several factors specific to each unit which would result in mothballing, retiring or replacing an existing unit. These factors along with their economics and methodology for retirement have been addressed in this study. Also discussed in this study is the historical electric utility industry and TVA experience on retiring of existing generating units. 5 figures, 13 tables.

2002 Environmental Aspects

REFER ALSO TO CITATION(S) 27793, 27797, 27798, 28856, 29205

28254 (DOE/ET/15491—1565) Hot gas cleanup using ceramic cross flow membrane filters. Final report. Ciliberti, D.F.; Smeltzer, E.E.; Alvin, M.A.; Keairns, D.L.; Bachovchin, D.M. (Westinghouse Electric Corp., Pittsburgh, PA (USA). Research and Development Center). Dec 1983. Contract AC21-79ET15491. 574p. NTIS, PC A24/MF A01; 1; GPO Dep. Order Number DE84003097.

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The single unresolved technical issue in the commercialization of pressurized fluid-bed combustion (PPBC) for electric power production is the hot gas cleaning problem. In this technology, high-temperature and -pressure (HTHP), dust-laden flue gases from the combustor must be cleaned enough to reduce expansion turbine blade erosion to an economically acceptable level. Additionally, the level of particulate emission must be compatible with the New Source Performance Standards (NSPS) for environmental acceptability. The Department of Energy (DOE) has sponsored a wide range of research and development programs directed at the solution of this problem. These programs were divided into two classifications, one dealing with more advanced concepts where testing was to be done at relatively large scale and a second group of less advanced, novel concepts where the testing was to be carried out at a bench scale. The cross-flow ceramic membrane filter program described in this report is a member of the small-scale, novel concept group.

28255 (EPRI-CS—3503) Evaluation of an advanced dual-register coal burner for utility boiler NO/sub x/ control. Final report. Johnson, S.A.; Lindstrom, G.D.; Sommer, T.M. (Babcock and Wilcox Co., Alliance, OH (USA). Research and Development Div.). May 1984. 68p. Electric Power Research Inst., Research Reports Center, P.O. Box 50490, Palo Alto, CA 94303. Order Number DE84920327.

In utility pulverized-coal boilers fired with wall-mounted burners, one means available to aid the control of NO/sub x/ emissons is to utilize burner designs that limit the mixing rate of air and fuel. As an example, The Babcock & Wilcox Company (B & W) has developed a dual-register burner (DRB) to achieve this limited turbulence. The objective of this work was to evaluate an advanced version of the DRB utilizing air slots on the burner wall outboard of the burner throat to further delay the mixing of air and fuel. This advanced dual-register burner (ADRB) concept was tested in both 50-million Btu/hr and 25-million Btu/hr scales. NO/sub x/ emission trends with this concept could be related to the inner-zone air/fuel stoichiometry and the direction and momentum of outer air injection. Under certain conditions, there is a slight benefit in injecting some of the combustion air outboard of the burner throat for controlling NO/sub x/ emissions (13% to 27% reduction) froma low-turbulence burner such as the B & W dual-register burner. For maximum benefit, the outboard air should be injected parallel to the burner axis and at low injection velocities. However, there is a complex interaction and trade-off between low inner-zone stoichiometries conductive to minimum NO/sub x/ formation and increased slot velocities which increase NO/sub x/ emissions. 11 references, 30 figures, 7 tables.

2003 Power Transmission And Distribution

28256 (AD-A—137704/3) Line voltage anomalies and optimized solutions. Carpenter, R.B. Jr. (Lightning Elimination Associates, Santa Fe Springs, CA (USA)). Apr 1983. 37p. NTIS, PC A03/MF A01.

The recent progress in electronic systems has brought with it an increased sensitivity to the operating environment. One aspect of that environment, the source of power, is also a source of destructive, disruptive and reliability-deterrent voltage anomalies. For more than eleven years Lightning Elimination Associates, Inc. (LEA) has been working in the field of protection systems. One result has been a natural evolution of protective products that match the industry requirements as they have evolved. Preparing a comprehensive definition of those requirements is as much a part of the protection task as the design of the protectors.

28257 (NP—4770274) Technique for overall dynamic simulation of electric power systems. Grossu-Viziru, A.M. (Eidgenoessische Technische Hochschule, Zurich (Switzerland)). 1981. 132p. NTIS (US Sales Only), PC A07/MF A01. Order Number DE84770274.

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The overall dynamic simulation of electric power systems (mnemonically called OVALDY) covers in one run the domain for which several different simulations are usually needed. The program accomplishing this simulation technique can replace those for

dynamic, mid-term, and long-term simulation, of course with acceptable computational effort. The simulation technique OVALDY uses a single-step implicit integration method. The size of the integration step is automatically controlled by the required solution precision and the transient behaviour of the simulated system. At the beginning and immediately after a system change (caused by the simulation), the step is small; it increases while the transients die out (a ratio of 12467 was observed over a simulation time of 6 minutes).

28258 **(ORNL/Sub—80-7974/1) Protection and safety of electric distribution systems with dispersed storage and generation devices.** Curtice, D.; Iqbal, S.; Ayoub, A.; Feero, W.; Griffin, C.; Jordin, G.; Kemph, M.; Kornburst, F.; Patton, J.; Phadke, A. (Systems Control, Inc., Palo Alto, CA (USA)). Apr 1984. Contract AC05-84OR21400. 259p. NTIS, PC A12/MF A01; 1; GPO Dep. Order Number DE84012027.

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The use of Dispersed Storage and Generation (DSG) Systems depends on the resolution of the technical and economic issues that surround their interconnection to electric utility systems. This report presents an analysis of protection and safety problems associated with DSG systems connected to distribution systems. Based on this analysis, protection requirements and interconnection schemes have been identified for DSG systems that differ in size, interconnection voltage, prime mover, and electrical interface (i.e., synchronous generator). The cost for the equipment, installation, maintenance, and utility services have been estimated. A sensitivity analysis was developed to determine the benefits of adding protection equipment for reducing DSG outages, DSG start-up costs, and lost revenues from energy sales. DSG safety issues were analyzed using present utility safe work procedures as a guide. Requirements and cost estimates for a system that automates the opening of DSG disconnect switches are discussed. Functional capabilities of a computer-based relay package for DSG systems is discussed. The package is described in terms of its self-diagnostic capability, data sharing for multiple functions, and functional flexibility for implementing completely new functions not considered possible with conventional relays.

21 NUCLEAR POWER PLANTS

REFER ALSO TO CITATION(S) 28393, 28419

28259 **(INIS-mf—8922) Publications catalogue 1982-83.** (Atomic Energy Control Board, Ottawa, Ontario (Canada)). Apr 1982. 56p. NTIS (US Sales Only), PC A04/MF A01. Order Number DE84780208.

This catalogue lists the technical reports, papers, speeches, regulatory documents, news releases, information bulletins, notices, and miscellaneous documents issued by the Canadian Atomic Energy Control Board between 1977 and 1982.

28260 **(INIS-mf—8928) Scientific research and production introduction studies of light water reactor power plants. Volume 1. Conference proceedings.** Dolezal, A.; Vyskocil, V.; Chlumsky, V.; Vostrakova, I. (eds.). (Skoda, Plzen (Czechoslovakia)). 1981. 92p. (In Slovak). (CONF-8112102—Vol.1). NTIS (US Sales Only), PC A05/MF A01. Order Number DE84780241.

From Conference on scientific research and production introduction studies of light water reactor power plants; Karlovy Vary, Czechoslovakia (1 Dec 1981).

Individual items in scope for the data base were processed separately.

2101 Power Reactors, Non-breeding, Light-water Moderated, Boiling Water Cooled

REFER ALSO TO CITATION(S) 27999, 28364, 28365, 28368, 28369, 28370, 28376, 28382, 28384, 28406, 28408, 28409, 28410, 28414, 28421, 28430, 28432, 28433, 28435, 28437, 28441, 28444, 28449, 28454, 28455, 29249

28261 **(GEAP—30314) Nuclear design and core operation for the first irradiation cycle of the large-scale zirconium barrier fuel demonstration at Quad Cities 2.** Paustian, H.H.; Thompson, J.R. (General Electric Co., San Jose, CA (USA). Nuclear Fuel and Special Projects Div.). Mar 1984. Contract AC02-77ET34001. 62p. NTIS (US Sales Only), PC A04/MF A01; GPO Dep. Order Number DE84011821.

This report describes the nuclear design of the 144 demonstration zirconium barrier bundles inserted in the Quad Cities 2 core in December 1981. It also describes the locations of these bundles and their power histories during the first cycle of irradiation, the resulting linear heat generation rates (LHGRs) and fuel rod burnups when 16 of these zirconium barrier bundles were power ramped in March 1983, and the LHGRs and burnups in nearby nonbarrier fuel during this power ramping. Fuel failure probability estimates are discussed in the Appendix.

28262 **(INIS-mf—8929) Scientific research and production introduction studies of light water reactor power plants. Volume 2. Conference proceedings.** Dolezal, A.; Vyskocil, V.; Chlumsky, V.; Vostrakova, I. (eds.). (Skoda, Plzen (Czechoslovakia)). 1981. 83p. (In Czech). (CONF-8112102—Vol.2). NTIS (US Sales Only), PC A05/MF A01. Order Number DE84780242.

From Conference on scientific research and production introduction studies of light water reactor power plants; Karlovy Vary, Czechoslovakia (1 Dec 1981).

Individual items in scope for the data base are processed separately.

28263 **(INIS-mf—8930) Scientific research and production introduction studies for light water reactor power plants. Volume 3. dil.** Dolezal, A.; Vyskocil, V.; Chlumsky, V.; Vostrakova, I. (eds.). (Skoda, Plzen (Czechoslovakia)). 1981. 77p. (In Czech). (CONF-8112102—Vol.3). NTIS (US Sales Only), PC A05/MF A01. Order Number DE84780245.

From Conference on scientific research and production introduction studies of light water reactor power plants; Karlovy Vary, Czechoslovakia (1 Dec 1981).

Separate abstracts are presented for each of the papers included in the data base.

28264 **(IWGFPT—12) Examination of fuel assembly for water cooled power reactors.** (International Atomic Energy Agency, Vienna (Austria). International Working Group on Fuel Performance and Technology for Water Reactors). Apr 1982. 312p. (CONF-811157—). NTIS (US Sales Only), PC A14/MF A01. Order Number DE84900985.

From IAEA specialists' meeting on examination of fuel assembly for water cooled power reactors; Tokyo, Japan (9 Nov 1981).

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Papers are presented concerning site inspection experience power reactor fuel; hot cell examination experience of power reactor fuel; and special PIE techniques.

28265 **(NUREG—0020-Vol.8-No.3) Licensed operating reactors. Status summary report as of February 29, 1984. Volume 8, No. 3.** (Nuclear Regulatory Commission, Washington, DC (USA). Office of Resource Management). Apr 1984. 387p. NTIS, PC A17/MF A01 - GPO*. Order Number DE84901226.

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The US Nuclear Regulatory Commission's monthly Licensed Operating Reactors Status Summary Report provides data on the operation of nuclear units as timely and accurately as possible. This information is collected by the Office of Resource Management, from the Headquarters Staff of NRC's Office of Inspec-

tion and Enforcement (IE), from NRC's Regional Offices, and from utilities. This report is divided into three sections: the first contains monthly highlights and statistics for commercial operating units, and errata from previously reported data; the second is a compilation of detailed information on each unit, provided by NRC Regional Offices, IE Headquarters and the utilities; and the third section is an appendix for miscellaneous information such as spent fuel storage capability, reactor years of experience and non-power reactors in the United States.

28266 **(NUREG/CR—3391-Vol.2) LWR pressure vessel surveillance dosimetry improvement program. Volume 2. Quarterly progress report, April-June 1983.** Lippincott, E.P.; McElroy, W.N. (Hanford Engineering Development Lab., Richland, WA (USA)). Apr 1984. Contract AC06-76FF02170. 113p. (HEDL-TME—83-22). NTIS, PC A06/MF A01; 1 - GPO $5.00; GPO Dep. Order Number DE84008921.

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Information from Hanford Engineering Development Laboratory, Oak Ridge National Laboratory, and Rockwell International is presented concerning the radiation monitoring studies and radiation-induced embrittlement of pressure vessel steels in PWR and BWR type reactors.

28267 **(NUREG/CR—3595) Heavy-Section Steel Technology Program: five-year plan, FY 1983-1987.** (Oak Ridge National Lab., TN (USA)). Apr 1984. Contract AC05-84OR21400. 138 p. (ORNL/TM—9008). NTIS, PC A07/MF A01; 1 - GPO; GPO Dep. Order Number DE84011865.

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The first in an annual series of five-year program plan documents is presented for the Heavy-Section Steel Technology program. The program is carried out by the Oak Ridge National Laboratory for the Materials Engineering Branch, Division of Engineering Technology, Office of Nuclear Regulatory Research of the US Nuclear Regulatory Commission. The program is aimed at advancing the understanding and validation of materials and structures behavior as they relate to light water reactor pressure vessel integrity. The program has nine technical tasks and a management function. A background statement and a plan-of-action is given for each. The nine technical tasks address fracture methodology and analysis, materials characterization, crack growth, crack arrest, irradiation effects, cladding evaluations, intermediate-vessel testing, thermal-shock testing, and pressurized thermal-shock experiments.

28268 **(NUREG/CR—3664) Description and assessment of RAMONA-3B Mod.0 Cycle 4: a computer code with three-dimensional neutron kinetics for BWR system transients.** Wulff, W.; Cheng, H.S.; Diamond, D.J.; Khatib-Rahbar, M. (Brookhaven National Lab., Upton, NY (USA)). Jan 1984. Contract AC02-76CH00016. 429p. (BNL-NUREG—51746). NTIS, PC A19/MF A01; 1 - GPO; GPO Dep. Order Number DE84010607.

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This report documents the physical models and the numerical methods employed in the BWR systems code RAMONA-3B. The RAMONA-3B code simulates three-dimensional neutron kinetics and multichannel core hydraulics of nonhomogeneous, nonequilibrium two-phase flows. RAMONA-3B is programmed to calculate the steady and transient conditions in the main steam supply system for normal and abnormal operational transients, including the performances of plant control and protection systems. Presented are code capabilities and limitations, models and solution techniques, the results of development code assessment and suggestions for improving the code in the future.

28269 **(NUREG/CR—3741-Vol.1) Evaluation of power reactor fuel rod analysis capabilities. Phase 2 topical report. Volume 1. Data evaluation.** Coleman, D.R. (Control Data Corp., Rockville, MD (USA)). Apr 1984. 137p. NTIS, PC A07/MF A01 - GPO* $5.50. Order Number DE84901093.

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The acquisition, review, analysis, and processing of power reactor fuel performance data resources are described in this report. These data resources are characterized here to support subsequent evaluations of the NRC-sponsored fuel rod behavior code, FRAPCON. Application of the Fuel Performance Data Base is shown to provide the basic data files which are sorted, processed, and restructured to establish key parameters of interest on an individual rod basis. The design, operational, and performance parameters are analyzed to determine the data populations and the representation of various fuel design types in the data sample. Also presented are the performance data distribution and trends relative to operational parameters such as power and burnup, and a description of the data processing methods. Significant amounts of power reactor fuel performance data are available to support high burnup code evaluation studies. The data clearly indicate the cumulative effects of rod deformation, fission gas release, and corrosion, which tend to alter the as-built fuel rod thermal and mechanical conditions.

28270 **(NUREG/CR—3754) Failure evaluation of General Electric SB-1 and SB-9 reactor mode switches.** Bacanskas, V.P. (Franklin Research Center, Philadelphia, PA (USA)). Apr 1984. 37p. NTIS, PC A03/MF A01 - GPO* $3.75. Order Number DE84901104.

The SB-1 reactor mode switch that malfunctioned at Quad Cities Unit 1 was evaluated along with new SB-1 and SB-9 switches. The SB-1 reactor mode switch malfunctions were most probably the result of the switch being placed in the false detent position (an intermediate switch position just prior to the actual detent position), which allowed several of the contacts required to be closed to remain open. The false detent noted in the SB-1 switch operation is a result of the indexer mechanism design and not age-related conditions or a defect of a particular switch. The indexer mechanism for the SB-9 switch is of a different design and is not susceptible to a similar failure mechanism.

28271 **(PNL—5119) Review of maintenance personnel practices at nuclear power plants.** Chockie, A.D.; Badalamente, R.V.; Hostick, C.J.; Vickroy, S.C.; Bryant, J.L.; Imhoff, C.H. (Pacific Northwest Lab., Richland, WA (USA)). May 1984. Contract AC06-76RL01830. 69p. NTIS, PC A04/MF A01; 1; GPO Dep. Order Number DE84012140.

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As part of the Nuclear Regulatory Commission (NRC) sponsored Maintenance Qualifications and Staffing Project, the Pacific Northwest Laboratory (PNL) has conducted a preliminary assessment of nuclear power plant (NPP) maintenance practices. As requested by the NRC, the following areas within the maintenance function were examined: personnel qualifications, maintenance training, overtime, shiftwork and staffing levels. The purpose of the assessment was to identify the primary safety-related problems that required further analysis before specific recommendations can be made on the regulations affecting NPP maintenance operations.

28272 **(TVA/OP/FUE—84/6) QUAD+ BWR Fuel Assembly demonstration program at Browns Ferry plant.** Doshi, P.K.; Mayhue, L.T.; Robert, J.T.; Beu, T.D. (Westinghouse Electric Corp., Pittsburgh, PA (USA); Tennessee Valley Authority, Chattanooga (USA). Div. of Fuels). Apr 1984. 6p. (CONF-840412—7). NTIS, PC A02/MF A01. Order Number DE84901083.

From American power conference; Chicago, IL, USA (24 Apr 1984).

The QUAD+ fuel assembly is an improved BWR fuel assembly designed and manufactured by Westinghouse Electric Corporation. The design features a water cross separating four fuel minibundles in an integral channel. A demonstration program for this fuel design is planned for late 1984 in cycle 6 of Browns Ferry 2, a TVA plant. Objectives for the design of the QUAD+ demonstration assemblies are compatibility in performance and transparency in safety analysis with the feed fuel. These objectives are met. Inspections of the QUAD+ demonstration assemblies are planned at each refueling outage.

2102 Power Reactors, Non-breeding, Light-water Moderated, Non-boiling Water Cooled

REFER ALSO TO CITATION(S) 27943, 28263, 28264, 28265, 28266, 28267, 28269, 28271, 28332, 28334, 28357, 28364, 28365, 28368, 28374, 28376, 28383, 28385, 28392, 28399, 28405, 28406, 28414, 28415, 28416, 28417, 28418, 28420, 28421, 28431, 28432, 28435, 28438, 28441, 28445, 28447, 28448, 28449, 28455, 28459, 28463, 28465, 28466, 28789, 29030

28273 **(CEA-CONF—6823) Irradiation of four pencils fuel element clusters in the periphery of OSIRIS. Qualification of the calculation method by dosimetry.** Alberman, A.; Morin, C. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France)). Sep 1983. 8p. (In French). (CONF-8309186—2). NTIS (US Sales Only), PC A02/MF A01. Order Number DE84750632.

From 49. meeting of the French working group on dosimetry; Grenoble, France (21 Sep 1983).

The programs of qualification of PWR fuels required many irradiations in research reactors. In the periphery of the OSIRIS reactor (70 MW), two devices (IRENE and ISABELLE loops) recreating the environment of the fuel rods in power reactors have been put into service. In each device a fuel element cluster including four pencils was irradiated. The problem set by dosimetry was to calculate the enrichments of the pencils to obtain the required power level and to compensate the neutron flux gradient (in front of/behind) to obtain the same power on each one of the four pencils. The required accuracy is about 5%. Fuels dosimetry achieved on loops mockups in the ISIS reactor allowed to test the validity of the calculations and to calibrate the probes according to the nuclear power.

28274 **(CEA-CONF—6908) Pellet to cladding interaction modeling with the finite element code TITUS.** Joseph, J.; Lefebvre-Albaret, A.M.; Fillatre, A.; Schley, R. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France)). Aug 1983. 11p. (In French). (CONF-830805—80). NTIS (US Sales Only), PC A02/MF A01. Order Number DE84750633.

From 7. international conference on structural mechanics in reactor technology; Chicago, IL, USA (22 Aug 1983).

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The modeling of the behaviour of the cladding during a power ramp is important to evaluate the local stress in the clad during PWR transients. FRAGEMA and CEA have undertaken an important R and D program, on PCI, which includes an experimental part consisting of various power ramping and a theoretical part in order to model the behaviour of fuel rods during transients with the finite element code TITUS. Some analytical experiments were undertaken recently to improve and calibrate the numerical methods while the basis of the mechanical modeling was already presented during the SMIRT 6 conferences in Paris. The method has been improved by coupling the axisymmetric and radial calculations; the axial elongation is calculated by the axisymmetric model at each power step and introduced afterwards in the radial model by improving a variation for the thickness of the radial slab. This method allows to conserve the strain and stress state of the fuel in the radial case. A friction model has been introduced. An analytical experiment, ZADIG, was also performed in the OSIRIS reactor to calibrate the finite elements method.

28275 **(DOE/ET/34015—6) Dilute chemical cleaning of PWR steam generators off-line cleaning process evaluation.** Simon, G.P.; Smoot, D.E.; Schneidmiller, D. (UNC Nuclear Industries, Inc., Richland, WA (USA)). Jul 1983. Contract AC02-79ET34015. 113p. NTIS, PC A06/MF A01; 1; GPO Dep. Order Number DE84006506.

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This project evaluated the feasibility of using a low-concentration (~ 0.5 wt %) chemical cleaning process to remove corrosion product deposits from steam generator surfaces and magnetite from tube-to-support plate crevices of PWR steam generators. The primary objective was to develop a dilute process that could be safely applied at scheduled intervals, such as during normal refueling outages, to maintain a clean operating condition in the steam generator. The dilute chemical cleaning process developed in this project was demonstrated successfully on two model generators which were operated on faulted chemistry by DOE/CRC at Commonwealth's State Line Facility. Unit 5 was cleaned after 48 days of operation with 1% seawater fouling, and Unit 6 was cleaned after 112 days of operations with Lake Michigan water. This report describes work leading to the model generator cleaning demonstrations and provides details of the cleaning operation for each model steam generator.

28276 **(DOE/RL/10153—T1-Vol.5) Shippingport station decommissioning project: decommissioning plan. Volume No. 5.** (Burns and Roe Industrial Services Corp., Paramus, NJ (USA); Nuclear Energy Services, Inc., Danbury, CT (USA)). Aug 1983. Contract AC06-80RL10153. 336p. NTIS, PC A15/MF A01; 1; GPO Dep. Order Number DE84010908.

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The activity specifications for solid waste management, decontamination, sludge removal, decontamination of reactor coolant purification system, and systems operation support are given, together with supplementary requirements for welding and work breakdown structure dictionary. (DLC)

28277 **(EGG—2287) EPICOR II Research and Disposition Program: FY-1983 annual report.** Reno, H.W.; McConnell, J.W. Jr.; Schmitt, R.C. (EG and G Idaho, Inc., Idaho Falls (USA)). Apr 1984. Contract AC07-76ID01570. 35p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE84011793.

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The program is responsible for research and safe disposal of EPICOR II prefilter liners used during cleanup of Three Mile Island Unit 2 (TMI-2). Activities include receipt and interim storage of 50 EPICOR II prefilter liners; development, testing, and qualification of a high integrity container for liner disposal; completion of a disposal demonstration of one EPICOR II liner enclosed in a high integrity container at a commercial disposal facility; a disposal campaign for liners not used in research; and resin/liner research. This Annual REport summarizes major accomplishments made during FY-1983. Included are: (a) a synopsis of modifications to equipment in the Hot Shop of Test Area North; (b) a summary of negotiations with the State of Washington for use of high integrity containers in disposal of EPICOR II liners at the commercial disposal facility; (c) a brief description of findings from a study on internal/external corrosion of EPICOR II liners; (d) progress in resin research activities; and (e) descriptions of new equipment developed in the research phase of the Program.

28278 **(EPRI-NP—3198) Secondary water chemistry at Oconee.** Sawochka, S.G.; Pearl, W.L.; Bell, M.J.; Choi, S.S. (NWT Corp., San Jose, CA (USA)). Mar 1984. 134p. EPRI-RRC, Box 50490, Palo Alto, CA 94303. Order Number DE84920363.

As part of EPRI Program RP704-1, chemistry and OTSG corrosion data for Oconee were evaluated. Utility collected chemistry information was augmented by data collected during short and long term NWT sampling and analysis campaigns. Chemistry generally was controlled within Duke Power specifications; however, significant variations were observed with time and between units. Improvements in feedwater chemistry appear achievable by routing 100% rather than 50% of the moisture separator drains to the hotwell. In addition, more frequent precoating of the condensate filter/demineralizers would reduce levels of feedwater ionics and silica. However, the feedwater specifications, which are considered adequate by Duke Power Company for boiler and turbine corrosion minimization, have been met routinely.

28279 **(EPRI-NP—3274-Vol.1) Determination and verification of required water chemistry limits. Volume 1. Summary report. Final report.** Klisiewicz, J.W.; Wiatrowski, M.; Helyer, M.H.; Marugg, K.E.; Patel, B.M.; Sireci, J.E. (Combustion Engineering, Inc., Windsor, CT (USA). Nuclear Power Systems). Mar 1984. 270p. EPRI-RRC, Box 50490, Palo Alto, CA 94303. Order Number DE84920312.

Isothermal and heat transfer tests were employed to address the concerns of steam generator tube denting, particularly those conditions involved with the initiation of the denting process. Isothermal tests were used to establish relationships between dissolved condenser cooling-water species, tube denting, and associated corrosion morphology. Two low-heat-flux pot boiler tests were conducted to identify potential corrosion concerns of long term low-level condenser inleakage of seawater and of pH-adjusted fresh water (simulating cooling-tower operation). Two moderate-heat-flux model boiler tests were performed to evaluate the role of bulk water chloride and its effect on tube denting. The first test operated for 272 days, and NPM resulted in tube denting and subsequent support-plate cracking observed on the carbon steel drilled support plate. Tube denting was not observed at ferritic stainless steel support systems. The second test operated for 530 steaming days. Carbon steel drilled support-plate ligament cracking was observed after 52.3 ppM chloride days. During this test there was no evidence of accelerated corrosion of the ferritic stainless steel support systems and carbon steel eggcrate support systems.

28280 **(EPRI-NP—3278) Evaluation of field applications of boric acid in PWR steam generators. Final report.** Pearl, W.L.; Sawochka, S.G.; Choi, S.S. (NWT Corp., San Jose, CA (USA)). Mar 1984. 182p. EPRI-RRC, Box 50490, Palo Alto, CA 94303. Order Number DE84920365.

Secondary system chemistry and steam generator denting progression data for seven pressurized water reactors were reviewed in an attempt to evaluate the effects of boric acid addition on denting. Although laboratory data were conclusive relative to the beneficial effect of boric acid, data from KoRi 1, Indian Point 2, and Indian Point 3, where boric acid was employed for extensive periods, did not allow a similar conclusion to be developed for operating plants.

28281 **(EPRI-NP—3412) Transient simulation studies for PWR U-tube steam generators. Final report.** Adams, G.; Singhal, A.K.; Keetan, L.W. (Acurex Corp., Mountain View, CA (USA). Energy and Environmental Div.; CHAM of North America, Inc., Huntsville, AL (USA)). Mar 1984. 145p. EPRI-RRC, Box 50490, Palo Alto, CA 94303. Order Number DE84920364.

A 1/7-scale-model facility for simulating the natural circulating PWR U-tube steam generator has been designed and fabricated. The series of experiments representing thermal-hydraulic behavior of the U-tube steam generator under normal and off-normal conditions have been performed. The steady-state (normal) test results include the integral system behavior, natural circulation characteristics, and overall system heat transfer characteristics. The transient response (off-normal) data base includes simulation of loss of feed, primary line break, and steam line break events. The parametric study of the transient thermal-hydraulic response is provided. An application of the 3-D code (ATHOS) for evaluating the fairly severe transient (loss of feed) is performed, showing reasonable agreement between data and analysis.

28282 **(EPRI-NP—3460) Corrosion-product release in light water reactors.** Lister, D.H. (Atomic Energy of Canada Ltd., Chalk River, Ontario. Chalk River Nuclear Labs.). Mar 1984. 146p. Electric Power Research Inst., Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number DE84920347.

This research project is aimed at studying corrosion-product release from a range of reactor alloys under both PWR and BWR coolant chemistry conditions. The results of such a study will be ued to recommend ways by which corrosion-product release, and subsequent radiation fields, can be minimized in reactors. The investigation of corrosion-product release has so far employed three main techniques: in-reactor loop experiments to provide data on the effects of coolant chemistry and reactor irradiation; out-reactor loop experiments to provide kinetics data on release; and a combined radiotracer-surface analytical study of oxide films to provide mechanistic information on release. The results of the first year of the program are presented and discussed.

28283 **(EPRI-NP—3472) Decay heat removal experiments in a U-tube steam generator one-loop test facility. Final report.** Kiang, R.L.; Jeuck, P.R.; Eid, J.C. (SRI International, Menlo Park, CA (USA)). May 1984. 143p. EPRI-RRC, Box 50490, Palo Alto, CA 94303. Order Number DE84920339.

This final report documents the last year of an experimental program involving a U-tube steam generator two-loop test facility. This effort represents part of a multiyear research program aimed at providing a data base for future code verification. The year's work included major modifications to the facility: deactivating one loop to produce a one-loop facility and adding temperature, level, and conductivity information, especially in the U-tubes of the steam generator. Incorporated into the 12 days of testing were steady-state single-phase and two-phase primary natural circulation with single- and two-phase secondary at various water inventories and input powers, noncondensible gas injection, pump operation, simulation of overcooling transients and small-break loss-of-coolant accidents. The principal conclusion to be drawn from these tests is that single- or two-phase natural circulation can remove decay heat generated by the core.

28284 **(EPRI-NP—3477-Vol.1) PWR steam generator chemical-cleaning data base. Volume 1. Final report.** Capener, E.L.; Egan, G.R.; Feiereisen, T.J. (Aptech Engineering Services, Inc., Palo Alto, CA (USA)). Apr 1984. 55p. Electric Power Research Inst., Research Reports Center, P.O. Box 50490, Palo Alto, CA 94303. Order Number DE84920325.

A computerized data base has been designed to store, retrieve, and encourage the analysis of corrosion, sludge dissolution, and crevice cleaning results from a five-year research program aimed at developing a generic chemical cleaning process for PWR nuclear steam generators. An interactive system is provided to add future results to the data base. The data base and a computer code designed to interrogate it are available from the Electric Power Research Institute. Preliminary linear regression models are used to analyze the corrosion and sludge dissolution measurements from the Pot Boiler 5H and Model Boiler 7 tests sponsored by the Steam Generator Owners Group and thereby provide examples of the use of this data base in planning future work and interpreting past results.

28285 **(EPRI-NP—3477-Vol.2) PWR steam generator chemical-cleaning data base. Volume 2. Final report.** Capener, E.L.; Egan, G.R.; Feiereisen, T.J. (Aptech Engineering Services, Inc., Palo Alto, CA (USA)). Apr 1984. 200p. EPRI-RRC, Box 50490, Palo Alto, CA 94303. Order Number DE84920334.

A computerized data base has been designed to store, retrieve, and encourage the analysis of corrosion, sludge dissolution, and crevice cleaning results from a five-year research program aimed at developing a generic chemical cleaning process for PWR nuclear steam generators. An interactive system is provided to add future results to the data base. The data base and a computer code designed to interrogate it are available from the Electric Power Research Institute. Preliminary linear regression models are used to analyze the corrosion and sludge dissolution measurements from the Pot Boiler 5H and Model Boiler 7 tests sponsored by the Steam Generator Owners Group and thereby provide examples of the use of this data base in planning future work and interpreting past results.

28286 **(KFK—3469) Literature search on mechanical and physical properties of cladding materials for advanced pressurized water reactors (APWR) at high temperatures.** Petersen, C. (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Inst. fuer Material- und Festkoerperforschung; Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Projekt Nukleare Sicherheit). Oct 1983. 86p. (In German). NTIS (US Sales Only), PC A05/MF A01. Order Number DE84751306.

A comparison of alternative cladding materials such as austenitic and ferritic stainless steels for APWR with Zircaloy -4 as PWR cladding material demonstrate that there are no problems

with respect to neutron economy and chemical interaction with the coolant and fuel under reactor operating conditions. Fabrication costs of all materials are comparable. In reprocessing ferritic steels make difficulties. The mechanical stability of the steels is found to be better. Better physical properties are found for steels compared with Zircaloy at high temperatures. The mechanical properties determined in short term and long term tests at high temperatures (> 600°C) lead to a superiority of the steels in terms of higher strength and lower failure ductility compared to Zircaloy. Even neutron irradiation causes lower ductility in austenitic stainless steels - an advantage for the burst behavior of the cladding in an emergency accident. Data from temperature-transient high temperature creep tests should be evaluated to understand the safety behavior of steel cladding materials, and incorporated into model concepts.

28287 **(NUREG/CR—3641) Reliability assessment of Indian Point Unit 3 containment structure.** Kawakami, J.; Hwang, H.; Chang, M.T.; Reich, M. (Brookhaven National Lab., Upton, NY (USA)). Jan 1984. Contract AC02-76CH00016. 51p. (BNL-NUREG—51740). NTIS, PC A04/MF A01; 1 - GPO; GPO Dep. Order Number DE84010823.

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In the current design criteria, the load combinations specified for design of concrete containment structures are in the deterministic formats. However, by applying the probability-based reliability method developed by BNL to the concrete containment structures designed according to the criteria, it is possible to evaluate the reliability levels implied in the current design criteria. For this purpose, the reliability analysis is applied to the Indian Point Unit No. 3 containment. The details of the containment structure such as the geometries and the rebar arrangements, etc., are taken from the working drawings and the final safety analysis reports. Three kinds of loads are considered in the reliability analysis. They are, dead load (D), accidental pressure due to a large LOCA (P), and earthquake ground acceleration (E). Reliability analysis of the containment subjected to all combinations of loads is performed. Results are presented in this report.

28288 **(TVA/OP/NP—84/4) Watts Bar preventive maintenance program. Lectures 28.8.1-3.** (Tennessee Valley Authority, Chattanooga (USA). Div. of Nuclear Power). 1984. 28p. NTIS, PC A03/MF A01. Order Number DE84901140.

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This discussion about preventive maintenance (PM) at Watts Bar begins with how the plant sections are organized. The plant organization was a determining factor in how the preventive maintenance program was structured. Watts Bar has three maintenance sections - Mechanical, Electrical, and Instrument - that perform both corrective maintenance and preventive maintenance. In addition, there is an Engineering and Test Unit that performs vibration analyses and performance monitoring.

28289 **Pressurized water reactors.** Bush, S.H. (Pacific Northwest Laboratories, Richland, WA). pp 29-56 of Reliability of reactor pressure components. Proceedings of an international symposium organized by the IAEA and held in Stuttgart, 21-25 March 1983. Vienna, Austria; IAEA (1983). (CONF-830330—).

From IAEA conference on reliability; Suttgart, F.R. Germany (21 Mar 1983).

An overview of the pressurized water reactor (PWR) pressure boundary problems is presented. Specifically exempted will be discussions of problems with pumps, valves and steam generators on the basis that they will be covered in other papers. Pressure boundary reliability is examined in the context of real or perceived problems occurring over the past five to six years since the last IAEA Symposium on Reliability of Reactor Pressure Components. PWR piping has been subject to cracking or failure by a variety of mechanisms. Major failures have occurred because of dynamic loads combined with errors in design and/or fabrication. For example, secondary relief valves have been 'blown off' in two plants and a steam generator feedwater line has split because of water hammer loads. These and similar events will be discussed. Another cause of cracking has been thermal fatigue. Several cases of steam generator feedwater line cracking in Westinghouse plants will be cited. Recently (1982) several incidents of thermal fatigue cracking have occurred in Babcock and Wilcox primary systems, specifically in the region of the high pressure injection nozzles. Cracking has been both circumferential and axial with some instances of through-wall cracking; at least four plants have suffered cracking in safe ends; thermal sleeves have been contributors because of problems in fitup. A general discussion is given of failures in intermediate&sizes of PWR piping separate from the thermal hydraulic incidents. Another failure mechanism is intergranular stress corrosion cracking caused by a combination of environmental sensitization and thin-walled sections (Schedule 10-20); these have been limited to secondary or tertiary lines. Finally, on the base of the available data, the reliability of piping and vessels will be discussed.

2103 Power Reactors, Non-breeding, Graphite Moderated

REFER ALSO TO CITATION(S) 28265, 28435, 28450

28290 **(DOE/ET/34202—86) Advanced Gas Cooled Nuclear Reactor Materials Evaluation and Development Program. Monthly management status report, May 1983.** (General Electric Co., Schenectady, NY (USA). Advanced Reactor Systems Dept.). 20 Jun 1983. Contract AC02-76ET34202. 20p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE84011195.

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The focus of the FY83 materials program is to: (1) evaluate additional commercial Fe and Ni base high temperature alloys for possible use in a reformer/steam generator of an Advanced HTGR (Task 11); and (2) begin to develop the data base necessary for ASME Boiler and Pressure Vessel Code qualification and code extension (beyond T > 1400°F) for Incoloy 8C0H; a material which will undoubtedly be used in an Advanced HTGR system. During May 1983 effort continued on the program workscope as defined in XL-882-83C0628, dated March 9, 1983.

28291 **(GA-A—17388) HTGR applications program advanced systems. Semiannual report, April-October 1983.** (GA Technologies, Inc., San Diego, CA (USA)). Mar 1984. Contract AT03-76SF70046. 103p. NTIS, PC A06/MF A01; GPO Dep. Order Number DE84010488.

Information is presented concerning the nuclear core analysis design and fuel cycle costs; reactor internals; MRS decay heat removal studies; investment risk assessment; circulator design; fuel handling and control rod drive design; MRS prestressed concrete reactor vessel studies; MRS seismic analysis; and licensing support.

28292 **(GEFR—00693) High Temperature Gas-Cooled Reactor Program. Modular HTGR systems design and cost summary.** (General Electric Co., Sunnyvale, CA (USA)). Sep 1983. Contract AC03-80ET34034. 247p. NTIS, PC A11/MF A01; 1; GPO Dep. Order Number DE84010289.

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This report provides a summary description of the preconceptual design and energy product costs of the modular High Temperature Gas-Cooled Reactor (HTGR). The reactor system was studied for two applications: (1) reforming of methane to produce synthesis gas and (2) steam cycle/cogeneration to produce process steam and electricity.

2104 Power Reactors, Non-breeding, Otherwise Moderated Or Unmoderated

REFER ALSO TO CITATION(S) 28373

28293 **(EPRI-NP—3441) High-temperature electromagnetic filtration on the primary circuit of the Winfrith 100-MW nuclear plant.** Bridle, D.A.; Bird, E.J.; Mitchell, C.R. (UKAEA Atomic Energy Establishment, Winfrith. Technology Div.). May 1984. 94p. EPRI-RRC, Box 50490, Palo Alto, CA 94303. Order Number DE84920358.

This report details results of a program carried out by the UKAEA on the Winfrith SGHWR on the removal of particulate

corrosion species from the primary coolant by high temperature magnetic filtration. The program has utilized a small fixed grid research filter (5 te h^{-1} flow) operating, on a once-through basis, directly on the primary coolant blowdown line. Activated corrosion products, containing in particular ^{60}Co, are the dominant source which gives rise to occupational radiation exposure incurred in operating and maintaining most LWRs. The circulating crud in SGHWR is primarily hematite (α-Fe_2O_3) plus lesser amounts of magnetite (Fe_3O_4) and carries with it about 50% of the total ^{60}Co activity in circulation as particulates. Studies carried out as part of this program have optimized the filter operating variables in terms of flow rate, operating cycle, and backwash parameters for maximum filter efficiency. Data are presented on the filter performance for the major particulate corrosion products and associated nuclides together with particle size performance data at different flow rates. Additional studies have focussed on deposition rates before and after the magnetic filter on a range of LWR circuit materials. Deposited films have been characterized chemically and radiochemically and assessments made of the effect of magnetic separation on the physical structure and activity of such films.

28294 **(INIS-mf—8926) Exporting apocalypse: CANDU reactors and nuclear proliferation.** McKay, P. (Ontario Public Interest Research Group, Guelph (Canada)). 1984. 24p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE84780205.

The author believes that the peaceful use of nuclear technology leads inevitably to the production of nuclear weapons, and that CANDU reactors are being bought by countries that are likely to build bombs. He states that exports of reactors and nuclear materials cannot be defended and must be stopped.

2105 Power Reactors, Breeding

REFER ALSO TO CITATION(S) 28335, 28342, 28343, 28360, 28361, 28362, 28395, 28396, 28397, 28400, 28403, 28423, 28424, 28426, 28427, 28428, 28462

28295 **(CEA-CONF—6975) Study of the efficiency of the anti-convective thermal barrier of the Super-Phenix vessels inter space.** Durin, M.; Mejane, A. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France)). Aug 1983. 15p. (In French). (CONF-830805—84). NTIS (US Sales Only), PC A02/MF A01. Order Number DE84750639.

From 7. international conference on structural mechanics in reactor technology; Chicago, IL, USA (22 Aug 1983).

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In the LMFBR Phenix reactor, the junction between the primary vessel and the roof slab is a region of large thermal gradients. In order to limit the gradient in the primary vessel, a thermal barrier has been installed between the primary and the safety vessel. The purpose of this barrier is to prevent the penetration of hot gas in the upper part of the vessels inter space. Experimental results have been obtained on a full scale model representing a 25° vessel sector of the reactor. Different geometrical configurations have been tested for a large range of boundary condition: - perfectly tight barrier - no thermal barrier; - simulation of leakages on the barrier.

28296 **(CONF-840614—2) Heat-transfer calculations for a potted (solid matrix embedded) subassembly.** Betten, P.R. (Argonne National Lab., IL (USA)). 1984. Contract W-31-109-ENG-38. 8p. NTIS, PC A02/MF A01. Order Number DE84004004.

From Annual meeting of the American Nuclear Society; New Orleans, LA, USA (3 Jun 1984).

Standard Liquid Metal Fast Breeder Reactor (LMFBR) subassemblies used in the Experimental Breeder Reactor II (EBR-II) have been investigated for fuel-bundle distortion using a destructive examination method known as potting. The potting technique embeds and permanently fixes the fuel elements in a solid matrix that can be sectioned and polished to reveal details in the internal structure of the elements or subassembly. Thus, an advantage of the potting technique is that it permits investigation of the internal structure of the subassembly in situ, as this structure would be lost or significantly altered during subassembly disassembly. However, since the elements in the subassembly are radioactive, the potting material must efficiently conduct radioactive decay heat to the environment so that the melting or softening temperatures of the potting material are not exceeded. The purpose of this paper is to present the heat transfer calculations for a potted subassembly and to recommend a simplified method for solving similar problems.

28297 **(CONF-840614—25) MENT reconstruction and potting comparison of a LMFBR fuel bundle.** Betten, P.R.; Tow, D.M. (Argonne National Lab., IL (USA); EG and G Idaho, Inc., Idaho Falls (USA)). 1984. Contract W-31-109-ENG-38. 7p. NTIS, PC A02/MF A01; GPO Dep. Order Number DE84006423.

From Annual meeting of the American Nuclear Society; New Orleans, LA, USA (3 Jun 1984).

Since the advent of computer-assisted-tomography (CAT), the CAT techniques have been rapidly expanded to the nuclear industry. A number of investigators have applied these techniques to reconstruct the fuel bundle configuration inside a subassembly with various degrees of resolution; however, there has been little data available on the accuracy of these reconstructions, and no comparisons have been made with the internal structure of actual irradiated subassemblies. Some efforts have utilized pretest mock-ups to calibrate the CAT algorithms, but the resulting mock-up configurations do not necessarily represent an actual subassembly, so an exact comparison has been lacking. The purpose of this paper is to present the results of a comparison between a CAT reconstruction of an irradiated subassembly and the destructive examination of the same subassembly.

28298 **(CONF-840614—52) CAT reconstruction and potting comparison of a LMFBR fuel bundle.** Betten, P.R.; Tow, D.M. (Argonne National Lab., IL (USA); EG and G Idaho, Inc., Idaho Falls (USA)). Apr 1984. Contract W-31-109-ENG-38. 30p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE84012100.

From Annual meeting of the American Nuclear Society; New Orleans, LA, USA (3 Jun 1984).

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A standard Liquid Metal Fast Breeder Reactor (LMFBR) subassembly used in the Experimental Breeder Reactor II (EBR-II) was investigated, by remote techniques, for fuel bundle distortion by both nondestructive and destructive methods, and the results from both methods were compared. The non-destructive method employed neutron tomography to reconstruct the locations of fuel elements through the use of a maximum entropy reconstruction algorithm known as MENT. The destructive method consisted of "potting" (a technique that embeds and permanently fixes the fuel elements in a solid matrix) the subassembly, and then cutting and polishing the individual sections. The comparison indicated that the tomography reconstruction provided good results in describing the bundle geometry and spacer-wire locations, with the overall resolution being on the order of a spacer-wire diameter. A dimensional consistency check indicated that the element and spacer-wire dimensions were accurately reproduced in the reconstruction.

28299 **(CONF-840647—5) Seismic fluid-structure interaction analysis of a large LMFBR reactor.** Ma, D.C.; Gvildys, J.; Chang, Y.W. (Argonne National Lab., IL (USA)). 1984. Contract W-31-109-ENG-38. 43p. NTIS, PC A03/MF A01; GPO Dep. Order Number DE84006442.

From ASME pressure vessel and piping conference; San Antonio, TX, USA (17 Jun 1984).

This paper describes a seismic analysis which includes fluid-structure interactions for a large LMFBR reactor with many internal components and structures. Two mathematical models were employed. An axisymmetrical model was used for the vertical excitation analysis whereas a three-dimensional model was used for the horizontal excitation analysis. In both analyses, the sodium coolant was treated by continuum fluid elements. Thus, important seismic effects such as fluid-structure interaction, free-surface sloshing, fluid coupling, etc. are included in the analysis. This study is useful to the design of future LMFBR reactors. The results of this study can be used to improve the margin of safety of LMFBR plants under seismic conditions.

28300 **(CONF-840901—6) Three-dimensional nodal diffusion and transport methods for the analysis of fast-reactor critical experiments.** Lawrence, R.D. (Argonne National Lab., IL (USA)). 1984. Contract W-31-109-ENG-38. 6p. NTIS, PC A02/MF A01; GPO Dep. Order Number DE84011707.

From ANS topical meeting on physics and shielding; Chicago, IL, USA (17 Sep 1984).

This paper describes two new nodal methods for solving the multigroup neutron diffusion and transport equations in three-dimensional Cartesian geometry. These methods have been developed for the global analysis of fast-reactor critical experiments once cell-averaged multigroup cross sections for each matrix position or drawer have been computed using appropriate cell-homogenization procedures. Brief descriptions of the nodal diffusion and transport schemes are presented, along with results of two- and three-dimensional calculations for a current Zero Power Plutonium Reactor (ZPPR) configuration.

28301 **(HEDL-SA—2918-FP) Automated refueling inventory control system at FFTF.** Ordonez, C.R. (Hanford Engineering Development Lab., Richland, WA (USA)). Oct 1983. Contract AC06-76FF02170. 6p. (CONF-840614—40). NTIS, PC A02/MF A01; GPO Dep. Order Number DE84007168.

From Annual meeting of the American Nuclear Society; New Orleans, LA, USA (3 Jun 1984).

The Refueling Inventory Control System (RICS) at the Fast Flux Test Facility (FFTF) keeps track of all assemblies that reside in the various refueling facilities. The automated RICS allows the user to obtain information regarding any assembly under its control by displaying the data on a screen. It also provides a simulation mode which allows assembly moves on a duplicated data base. This simulation is used to verify the refueling documentation before it is issued.

28302 **(HEDL-SA—2959) Damping in LMFBR pipe systems.** Anderson, M.J.; Barta, D.A.; Lindquist, M.R.; Renkey, E.J.; Ryan, J.A. (Hanford Engineering Development Lab., Richland, WA (USA)). Jun 1983. Contract AC06-76FF02170. 16p. (CONF-840647—4). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE84006546.

From ASME pressure vessel and piping conference; San Antonio, TX, USA (17 Jun 1984).

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LMFBR pipe systems typically utilize a thicker insulation package than that used on water plant pipe systems. They are supported with special insulated pipe clamps. Mechanical snubbers are employed to resist seismic loads. Recent laboratory testing has indicated that these features provide significantly more damping than presently allowed by Regulatory Guide 1.61 for water plant pipe systems. This paper presents results of additional in-situ vibration tests conducted on FFTF pipe systems. Pipe damping values obtained at various excitation levels are presented. Effects of filtering data to provide damping values at discrete frequencies and the alternate use of a single equivalent modal damping value are discussed. These tests further confirm that damping in typical LMFBR pipe systems is larger than presently used in pipe design. Although some increase in damping occurred with increased excitation amplitude, the effect was not significant. Recommendations are made to use an increased damping value for both the OBE and DBE seismic events in design of LMFBR pipe systems.

28303 **(HEDL-SA—3131-FP) Experience with oxide fuel for advanced reactors.** Leggett, R.D. (Hanford Engineering Development Lab., Richland, WA (USA)). Apr 1984. Contract AC06-76FF02170. 6p. (CONF-840412—6). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE84011474.

From American power conference; Chicago, IL, USA (24 Apr 1984).

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This paper focuses on the use and potential of oxide fuel system for the LMFBR. The flawless performance of mixed oxide (UO_2-PuO_2) fuel in FFTF to 100,000 MWd/MTM is reviewed and means for achieving 200,000 MWd/MTM are presented. This includes using non-swelling alloys for cladding and ducts to overcome the limitations caused by swelling of the current alloys. Examples are provided of the inherently safe characteristics of oxide fuel including a large negative Doppler coefficient, its dispersive nature under hypothetical accident scenarios, and the low energy molten fuel-coolant interaction. Developments in fuel fabrication and reprocessing that stress safety and reduced personnel exposure are presented. Lastly, the flexibility to design for maximum fuel supply (high breeding gain) or minimum fuel cost (long lifetime) is shown.

28304 **(KFK—3505) Fast breeder fuel element development.** Marth, W.; Muehling, G. (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Projekt Schneller Brueter). Aug 1983. 242p. (In German). (CONF-8211151—). NTIS (US Sales Only), PC A11/MF A01. Order Number DE84751327.

From Seminar on fast breeder fuel element development; Karlsruhe, F.R. Germany (15 Nov 1982).

This report is a compilation of the papers which have been presented during a seminar "Fast Breeder Fuel Element Development" held on November 15/16, 1982 at KfK. The papers give a survey of the status, of the obtained results and of the necessary work, which still has to be done in the frame of various development programmes for fast breeder fuel elements. In detail the following items were covered by the presentations: - the requirements and boundary conditions for the design of fuel pins and elements both for the reference concept of the SNR 300 core and for the large, commercial breeder type of the future (presentation 1,2 and 6); - the fabrication, properties and characterization of various mixed oxide fuel types (presentations 3,4 and 5); - the operational fuel pin behaviour, limits of different design concepts and possible mechanism for fuel pin failures (presentations (7 and 8); - the situation of cladding- and wrapper materials development especially with respect to the high burn-up values of commercial reactors (presentations 9 and 10); - the results of the irradiation experiments performed under steady-state and non-stationary operational conditions and with failed fuel pins (presentations 11, 12, 13 and 14).

28305 (KFK—3505, pp 4-24) **Marginal conditions and goals in the development of fuel elements concerning core design.** Wehmann, U. Aug 1983. (In German). NTIS (US Sales Only), PC A11/MF A01. Order Number DE84751327. (CONF-8211151—). TI84751327

From Seminar on fast breeder fuel element development; Karlsruhe, F.R. Germany (15 Nov 1982).

The paper on hand deals with rod diameters, maximum burn-up and consequences for wrapping dimensions and structural materials as well as spacer devices.

28306 (KFK—3505, pp 25-37) **Work on the development of the structure of fuel elements.** Wenk, K.H. Aug 1983. (In German). NTIS (US Sales Only), PC A11/MF A01. Order Number DE84751327. (CONF-8211151—). TI84751327

From Seminar on fast breeder fuel element development; Karlsruhe, F.R. Germany (15 Nov 1982).

This paper is meant to give a roundup of development work concerning fuel element structure as support and cladding of fuel rods. The fuel element structure is a link between reactor vessel and the power-producing fuel rods, i.e. both the reactor arrangement and fuel rods influence the design of the fuel element structure, whereas the fuel element structure also determine marginal conditions for plant and fuel rods.

28307 (KFK—3505, pp 38-50) **Fuel production comparison of different types.** Wedemeyer, H.; Muehling, G. Aug 1983. (In German). NTIS (US Sales Only), PC A11/MF A01. Order Number DE84751327. (CONF-8211151—). TI84751327

From Seminar on fast breeder fuel element development; Karlsruhe, F.R. Germany (15 Nov 1982).

Marginal conditions relevant for the development of fuel pellets such as the choice of procedural steps that ought to be as simple as possible or the use of UO_2 powder apt for final sintering operation lead to mixed-oxide fuels of Mark Ia type, produced by mechanically mixing UO_2- and PuO_2-powders and subsequent sintering. Mark Ia fuel which was developed both in laboratory scale and industrial scale was well tested in irradiation experiments from

1970 through 1975. When experiments on irradiated fuel concerning its reprocessing ability showed that the irradiated mixed oxide was not satisfactorily soluble in boiling nitric acid, it became necessary to alter the production concept and to produce fuel that is already soluble before being irradiated (mixed oxide fuel Mark II type). This requirement was met by developing a granular fuel (OKOM-type fuel) as well as by developing a coprecipitated $(U,Pu)O_2$ source material (AUPuC-type fuel).

28308 (KFK—3505, pp 51-69) **Characteristics of mixed oxide fuel pellets and the respective source products.** Vollath, D. Aug 1983. (In German). NTIS (US Sales Only), PC A11/MF A01. Order Number DE84751327. (CONF-8211151—). TI84751327

From Seminar on fast breeder fuel element development; Karlsruhe, F.R. Germany (15 Nov 1982).

This survey exemplarily shows results of select assays on source materials, intermediate products and finished fuel pellets. Fuel from different charges are being compared. This comparison is meant to point out the problem of insufficient specifications of the fuel structure of breeder fuel, as opposed to light-water reactor fuel.

28309 (KFK—3505, pp 70-80) **Assays on homogeneity of the mixed oxide at various stages of the fuel cycle.** Kleykamp, H.; Pejsa, R. Aug 1983. (In German). NTIS (US Sales Only), PC A11/MF A01. Order Number DE84751327. (CONF-8211151—). TI84751327

From Seminar on fast breeder fuel element development; Karlsruhe, F.R. Germany (15 Nov 1982).

The uranium/plutonium and oxygen/metal homogeneities are measured fro KNK II/1 standard mixed oxides and for AUPuC mixed oxides irradiated in the FR 2-Vg. 7/II experiment within the different stages of the fuel cycle. The U-Pu distribution in unirradiated pellets, in irradiated pins and in the undissolved fraction of the fuel after the reprocessing is measured in standart mixed oxides. The concentration and the distribution of the plutonium in the blankets of pins from different irradiation experiments are given. For the AUPuC mixed oxides are determined in particular the oxigen distribution of after-oxidized unirradiated pellets, the fuel relocation and the formation of new phases in irradiated pins, and the composition of the residues from the dissolution of the fuel.

28310 (KFK—3505, pp 81-97) **Fuel pin requirements and design.** Kummerer, K. Aug 1983. (In German). NTIS (US Sales Only), PC A11/MF A01. Order Number DE84751327. (CONF-8211151—). TI84751327

From Seminar on fast breeder fuel element development; Karlsruhe, F.R. Germany (15 Nov 1982).

The overall design of the reactor core determines the basic data for the fuel element design. Non-standard operational statuses, i.e. unplanned yet actually occurring, can be limited by experiments and calculations due to practical experience. This is far more difficult with actual accidents where the consequences of such an accident must be anticipated from a small number of simulation experiments. Requirements to be met concerning outer fuel cycle and reactor safety can partly be specified quantitatively, in any case in qualitative terms. The actual constructional design of the SNR-300 fuel element is in accordance with the requirements that can be specified today, whereas the whole concept and design data were determined much earlier.

28311 (KFK—3505, pp 98-110) **Fuel behaviour and fuel pin failure probability.** Dienst, W. Aug 1983. (In German). NTIS (US Sales Only), PC A11/MF A01. Order Number DE84751327. (CONF-8211151—). TI84751327

From Seminar on fast breeder fuel element development; Karlsruhe, F.R. Germany (15 Nov 1982).

Owing to anticipated detrimental effects of low fuel sintering density with respect to the combined mechanical/chemical interactions of fuel and cladding, far higher fuel density appears to be imperative. There has been no doubt about the aptidude of the reference cladding steel-DIN-I-4970 under the aspects mentioned herein, whereas the cladding steel-DIN-I-4981 is likely to show weaknesses concerning the combined mechanical/chemical interactions with the fuel. The possibility of peaks in cladding strain caused by an accumulation of cesium needs checking out with standard-length fuel pins. After a long period of reactor power derating or predictable raise of rod power, a power increase is to be done very slowly. For fuel pins having a low fuel sintering density low rod power operation at the start does not seem to be advantageous.

28312 (KFK—3505, pp 111-124) **Combination of fuel-cladding chemical and mechanical interactions in mixed oxide fuel pins.** Goetzmann, O. Aug 1983. (In German). NTIS (US Sales Only), PC A11/MF A01. Order Number DE84751327. (CONF-8211151—). TI84751327

From Seminar on fast breeder fuel element development; Karlsruhe, F.R. Germany (15 Nov 1982).

A combination of mechanical/chemical interactions is quite unlikely to occur in standard reactor operation. The situations described herein are to show under what conditions they may occur. Mechanical interactions are favoured by frequent load-following operation where the level of power increase is so high that material transport within the fuel takes place in evaporation - condensation processes. Chemical interactions are favoured by high rod power and law fuel density. Piles of fuel pellets with varying cold gaps or fuel density are particularly dangerous. The allow the combination of mechanical and chemical interactions. With impurity elements check in particular the halogen content.

28313 (KFK—3505, pp 125-146) **State-of-the-art in cladding materials development for the SNR reference concept - critical materials problems.** Schneider, W.; Herschbach, K.; Schaefer, L.; Schirra, M.; Wassilew, C.; Ehrlich, K. Aug 1983. (In German). NTIS (US Sales Only), PC A11/MF A01. Order Number DE84751327. (CONF-8211151—). TI84751327

From Seminar on fast breeder fuel element development; Karlsruhe, F.R. Germany (15 Nov 1982).

Under the influence of high-energy neutron irradiation in fast breeder reactor cores, the steels used for the construction of fuel pin and wrapping suffer changes in their quality, which leads to shorter core residence time than in unirradiated condition. Out of the multifarious effects, this is an enumeration of those that are to be considered today as parameters possibly limiting the use. In principal, these are the following three: dimensional instability owing to pore swelling and in-pile creep; changes of creep-rupture characteristics due to irradiation; and interior corrosion caused by fission products influencing solidity and ductility.

28314 (KFK—3505, pp 147-177) **Development of materials for higher burn-up rates.** Ehrlich, K.; Anderko, K. Aug 1983. (In German). NTIS (US Sales Only), PC A11/MF A01. Order Number DE84751327. (CONF-8211151—). TI84751327

From Seminar on fast breeder fuel element development; Karlsruhe, F.R. Germany (15 Nov 1982).

The results obtained so far concerning both high-nickel austenitic steels (X10CrNiMoTiB10 25) and ferritic-martensitic steels (X18CrMoVNb12 1 corresponds to 1.4914) justify the expectations placed in these materials. Future R and D work will concentrate on high-nickel austenitic steels, in particular on in-pile residence time in the range of maximum cladding mean temperatures (He embrittlement), on confirmation of the fairly good swelling and creep behaviour to be obtained from neutron irradiation experiments as well as on material qualification and technology. As far the development in the field of martensitic steels the major question concerns the influence of neutron irradiation on the transient temperature. It is just as important and interesting to detect and describe the ruling in-pile creep mechanism in the 400 to 600°C range. Furthermore, questions on the fabrication and qualification of cladding tube boxes are also preeminent.

28315 (KFK—3505, pp 178-196) **Steady-state irradiation experiments.** Geithoff, D. Aug 1983. (In German). NTIS (US Sales Only), PC A11/MF A01. Order Number DE84751327. (CONF-8211151—). TI84751327

From Seminar on fast breeder fuel element development; Karlsruhe, F.R. Germany (15 Nov 1982).

This paper describes the steady-state irradiation experiments DFR-350, RAPSODIE-I and DFR-455 to be milestones in the development of the SNR Mk Ia fuel rod concept and also a number

of relevant results. For the two defective fuel elements from the KNK-2 reactor, in particular for the BE 202 IA, the status of the fuel rods is described on the basis of results obtained at the various stages of post-irradiation examination. The comparison of these results with those from previous experiments shows the value of such results for these rods. Thus the fuel rod behaviour in different circumstances is evaluated in qualitative terms.

28316 (KFK—3505, pp 197-214) **Fuel and fuel rod irradiation from an international angle.** Heyne, C. Aug 1983. (In German). NTIS (US Sales Only), PC A11/MF A01. Order Number DE84751327. (CONF-8211151—). TI84751327

From Seminar on fast breeder fuel element development; Karlsruhe, F.R. Germany (15 Nov 1982).

The present experience is based on rods belonging to one of these 3 categories: 1. experimental irradiation, 2. prototype irradiation, and 3. defect studies. For the illustration of the DeBeNe position, the international status concerning these points is shown. All in all, 200.000 rods have been irradiated under various circumstances. The highest burnup rates achieved were 200.000 MWD/tsub(M) and toses of appr. 120 dpa-NRT. Experience shows that most burnup rates were close to 100.000 MWD/tsub(M) and doses around 80 dpa-NRT. Defect rates are satisfactorily low. Great progress has been made in the field of irradiation of fuel and cladding material. The ambitious goal of producing an economical fuel element providing a 150.000 MWD/tsub(M) burnup and doses of 160 dpa-NRT appears to be feasable. DeBeNe results ensure our catching up with international standards despite their lack of universal import.

28317 (KFK—3505, pp 215-224) **Irradiation experiments on operational transients behaviour.** Plitz, H.; Freund, D. Aug 1983. (In German). NTIS (US Sales Only), PC A11/MF A01. Order Number DE84751327. (CONF-8211151—). TI84751327

From Seminar on fast breeder fuel element development; Karlsruhe, F.R. Germany (15 Nov 1982).

Within the system of an SNR-type reactor operational transients may occur that do not affect reactor safety, but possibly plant availability. These possible operational transients and their consequences on fuel rod behaviour are systematically examined. In irradiation tests SNR fuel rods are tested under the following conditions: - regular operation (load-following operation, steadily increasing output), - low power transients, - low cladding temperature transients. These experiments will first be carried out with new fuel rods, subsequently with pre-irradiated fuel rods in sodium capsules at the HFR Petten/Netherlands as well as in sodium loops at the BR-2 in Mol/Belgium.

28318 (KFK—3505, pp 225-237) **Fuel rod failure experiments - VOLGA programme.** Weimar, P.; Kleykamp, H. Aug 1983. (In German). NTIS (US Sales Only), PC A11/MF A01. Order Number DE84751327. (CONF-8211151—). TI84751327

From Seminar on fast breeder fuel element development; Karlsruhe, F.R. Germany (15 Nov 1982).

Even in steady-state operation of fast breeder reactors rod failures can not be totally excluded. The defect rate for fast breeder reactors will be pretty much the same as for LWR-type reactors, i.e. 0.1%. Appropriate quality control can probably exclude fuel rod failure at an early stage. We therefore took into consideration "end-of-life" failures only, i.e. failures occurring at a high-burnup stage. This kind of rod failure is frequently to be found at the fuel supports, the so-called cladding hot spot. This part of the fuel cladding is weakened by interior corrosion in must cases, and the fuel element is likely to fail when further loaded.

28319 (LA-UR—83-3514) **Slideline verification for multilayer pressure vessel and piping analysis including tangential motion.** Van Gulick, L.A. (Los Alamos National Lab., NM (USA)). 1984. Contract W-7405-ENG-36. 26p. (CONF-840647—2). NTIS, PC A03/MF A01; GPO Dep. Order Number DE84004333.

From ASME pressure vessel and piping conference; San Antonio, TX, USA (17 Jun 1984).

Nonlinear finite element method (FEM) computer codes with slideline algorithm implementations should be useful for the analysis of prestressed multilayer pressure vessels and piping. This paper presents closed form solutions including the effects of tangential motion useful for verifying slideline implementations for this purpose. The solutions describe stresses and displacements of a long internally pressurized elastic-plastic cylinder initially separated from an elastic outer cylinder by a uniform gap. Comparison of closed form and FEM results evaluates the usefulness of the closed form solution and the validity of the sideline implementation used.

2106 Power Reactors, Auxiliary, Mobile, Package, And Transportable

REFER ALSO TO CITATION(S) 28736, 28737, 28738, 28740, 28742

28320 (CONF-8308130—) **Refractory alloy technology for space nuclear power applications.** Cooper, R.H. Jr.; Hoffman, E.E. (eds.). (USDOE Technical Information Center, Oak Ridge, TN). Jan 1984. Contract W-7405-ENG-26. 285p. NTIS, PC A13/MF A01. Order Number DE84001745.

From Symposium on refractory alloy technology for space nuclear power applications; Oak Ridge, TN, USA (10 Aug 1983).

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Purpose of this symposium is twofold: (1) to review and document the status of refractory alloy technology for structural and fuel-cladding applications in space nuclear power systems, and (2) to identify and document the refractory alloy research and development needs for the SP-100 Program in both the short and the long term. In this symposium, an effort was made to recapture the space reactor refractory alloy technology that was cut off in midstream around 1973 when the national space nuclear reactor program began in the early 1960s, was terminated. The six technical areas covered in the program are compatibility, processing and production, welding and component fabrication, mechanical and physical properties, effects of irradiation, and machinability. The refractory alloys considered are niobium, molybdenum, tantalum, and tungsten. Thirteen of the 14 pages have been abstracted separately. The remaining paper summarizes key needs for further R and D on refractory alloys. (DLC)

28321 (CONF-8308130—, pp 1-4) **Origin and organization of the SP-100 program.** Ambrus, J.H. 1984. NTIS, PC A13/MF A01. Order Number DE84001745. TI84001745

From Symposium on refractory alloy technology for space nuclear power applications; Oak Ridge, TN, USA (10 Aug 1983).

The next step for occupying space is to build a space station. Energy demands for such a project grow larger the more often we look at them. To provide such high power for long periods of time is likely to require a nuclear reactor. The task force therefore looked around and asked, Is there a space nuclear reactor? JPL and LANL started talking to each other. After a lot of negotiation, the three agencies - DOE, NASA, and DARPA - created a tri-agency program to develop space reactor power system technology.

28322 (CONF-8308130—, pp 5-13) **SP-100 Program overview.** Truscello, V.C. 1984. NTIS, PC A13/MF A01. Order Number DE84001745. TI84001745

From Symposium on refractory alloy technology for space nuclear power applications; Oak Ridge, TN, USA (10 Aug 1983).

The SP-100 Program is expected to go through three phases: technology assessment and advancement, ground testing, and flight qualification. Currently the program is in the two- to three-year technology assessment and advancement stage. Goals are to identify the space nuclear power system concept that best meets anticipated requirements of future space missions, assess the technical feasibility of that concept, and establish a cost and schedule for developing the concept. The SP-100 Project Office has begun the implementation activities needed to meet these goals. With regard to refractory alloys, a better data base will be required before we move ahead in the program from technology assessment to ground demonstration.

28323 (CONF-8308130—, pp 14-17) **Potential refractory alloy requirements for space nuclear power applications.** Cooper, R.H. Jr. (Oak Ridge National Lab., TN). 1984. NTIS, PC A13/MF A01. Order Number DE84001745. Contract W-7405-ENG-26. TI84001745

From Symposium on refractory alloy technology for space nuclear power applications; Oak Ridge, TN, USA (10 Aug 1983).

In reviewing design requirements for refractory alloys for space nuclear applications, several key points are identified. First, the successful utilization of refractory alloys is considered an enabling requirement for the successful deployment of high efficiency, lightweight, and small space nuclear systems. Second, the recapture of refractory alloy nuclear technology developed in the 1960s and early 1970s appears to be a pacing activity in the successful utilization of refractory alloys. Third, the successful application of refractory alloys for space nuclear applications will present a significant challenge to both the materials and the systems design communities.

28324 (CONF-8308130—, pp 18-33) **Refractory alloy component accomplishments from 1963 to 1972.** Hoffman, E.E. 1984. NTIS, PC A13/MF A01. Order Number DE84001745. TI84001745

From Symposium on refractory alloy technology for space nuclear power applications; Oak Ridge, TN, USA (10 Aug 1983).

The components described include: Mo-TZM and Mo-TZC potassium turbine components, T-111/lithium valve test loop, Nb-1Zr Rankine system corrosion test loop, T-111 Rankine system corrosion test loop, electromagnetic pump, Nb-1Zr solar Brayton heat receiver, and T-111 boiler test system. (DLC)

28325 (CONF-8308130—, pp 34-85) **Compatibility of refractory alloys with space reactor system coolants and working fluids.** DeVan, J.H.; DiStefano, J.R.; Hoffman, E.E. (Oak Ridge National Lab., TN). 1984. NTIS, PC A13/MF A01. Order Number DE84001745. Contract W-7405-ENG-26. TI84001745

From Symposium on refractory alloy technology for space nuclear power applications; Oak Ridge, TN, USA (10 Aug 1983).

The bulk of this report deals with compatibility studies in liquid lithium and boiling potassium. Substantial information is also presented concerning the reactivity of niobium and tantalum alloys with residual gases in high and ultrahigh vacuum atmospheres. The remaining information, which is much less extensive, covers the compatibility behavior of molybdenum and tungsten alloys in alkali metals and a qualitative assessment of the use of refractory metals for containing helium in a closed Brayton cycle. 22 references, 29 figures, 14 tables.

28326 (CONF-8308130—, pp 168-226) **Refractory alloy component fabrication.** Young, W.R. 1984. NTIS, PC A13/MF A01. Order Number DE84001745. TI84001745

From Symposium on refractory alloy technology for space nuclear power applications; Oak Ridge, TN, USA (10 Aug 1983).

Purpose of this report is to describe joining procedures, primarily welding techniques, which were developed to construct reliable refractory alloy components and systems for advanced space power systems. Two systems, the Nb-1Zr Brayton Cycle Heat Receiver and the T-111 Alloy Potassium Boiler Development Program, are used to illustrate typical systems and components. Particular emphasis is given to specific problems which were eliminated during the development efforts. Finally, some thoughts on application of more recent joining technology are presented. 78 figures.

28327 (N—76-18259) **T-111 rankine system corrosion test loop. Volume II.** Harrison, R.W.; Hoffman, E.E.; Smith, J.P. (General Electric Co., Cincinnati, OH (USA). Nuclear Systems Programs). Jun 1975. 239p. (NASA-CR—134816-Vol.2; GESP—695-Vol.2). NTIS, PC A11/MF A01. Order Number DE84901106.

This report covers the results of a program whose objective was to determine the performance of refractory metal alloys in a two loop Rankine test system. The test system consisted of a circulating lithium circuit heated to 1230°C maximum transferring heat to a boiling potassium circuit with a 1170°C superheated vapor temperature. The results demonstrate the suitability of the selected refractory alloys to perform from a chemical compatibility standpoint.

28328 (PB—84-148568) **Advanced nuclear systems for portable power in space. Final report.** (National Academy of Sciences - National Research Council, Washington, DC (USA)). 1983. 60p. NTIS, PC A04/MF A01.

The Committee was charged with undertaking an assessment of 'the state of the art of advanced nuclear systems for portable thermal and electrical power systems with possible aerospace propulsion applications.' The principal vehicle for accomplishing this objective was the organization of a Symposium on Advanced Compactor Reactor Systems, which was held in Washington, D.C. for a 3-day period, November 15-17, 1982. The proceedings of the symposium have been published separately. The second product of the Committee's effort is this report, which presents the Committee's assessment and judgment of the prospects for advanced nuclear power systems for aerospace application. One application, space nuclear power, has been identified for particular attention. The bulk of this report is directed toward an assessment of the need for space nuclear power and the type of research and development program that is indicated. The Committee believes that space nuclear power will be important to the future of this nation. However, until the leadtime to acquire and deploy an operational nuclear power system is shortened to match that of the space system it would support, it will not appear to be a viable technical option for responsible program management.

2107 Regulation And Licensing

REFER ALSO TO CITATION(S) 27999, 28407, 28435, 28526

28329 (INIS-mf—8378) **Reactor licensing procedure.** Roser, T. (Deutsches Atomforum e.V., Bonn (Germany, F.R.)). Mar 1983. 9p. (In German). NTIS (US Sales Only), PC A02/MF A01. Order Number DE84780207.

Little is known about the fact that the licencing procedure for the construction and operation of nuclear power plants has to conform with strict regulations that every party involved must comply with. This article is meant to describe such regulations and how they are exercised in practice. (orig./HSCH).

28330 (NUREG—0748-Vol.4-No.3) **Operating reactors licensing actions summary. Vol. 4, No. 3.** (Nuclear Regulatory Commission, Washington, DC (USA). Office of Resource Management). May 1984. 351p. NTIS, PC A16/MF A01 - GPO*. Order Number DE84901138.

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The Operating Reactors Licensing Actions Summary is designed to provide the Management of the Nuclear Regulatory Commission (NRC) with an overview of licensing actions dealing with the operating power and nonpower reactors.

28331 (NUREG—1055) **Improving quality and the assurance of quality in the design and construction of nuclear power plants: a report to Congress.** Altman, W.; Ankrum, T.; Brach, W. (Nuclear Regulatory Commission, Washington, DC (USA). Office of Inspection and Enforcement). May 1984. 522p. NTIS, PC A22/MF A01 - GPO. Order Number DE84901187.

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A study was conducted of existing and alternative programs for improving quality and the assurance of quality in the design and construction of commercial nuclear power plants. A primary focus of the study was to determine the underlying causes of major quality-related problems in the construction of some nuclear power plants and the untimely detection and correction of these problems. The study concluded that the root cause for major quality-related problems was the failure or inability of some utility managements to effectively implement a management system that ensured adequate control over all aspects of the project. These management shortcoming arose in part from inexperience on the part of some project teams in the construction of nuclear power plants. NRC's past licensing and inspection practices did not adequately screen construction permit applicants for overall capability to manage or provide effective management oversight over the construction project. The study recommends a number of improvements in industry and NRC programs. For industry, the study recommends self-imposed

rising standards of excellence, treatment of quality assurance as a management tool, not a substitute for management, improved trend analysis and identification of root causes of quality problems, and a program of comprehensive third party audits of present and future construction projects. To improve NRC programs, the study recommends a heavier emphasis on team inspections and resident inspectors, an enhanced review of new applicant's capabilities to construct commercial nuclear power plants, more attention to management issues, improved diagnostic and trending capabilities, improved quality and quality assurance for operating reactors, and development of guidance to facilitate the prioritization of quality assurance measures commensurate with the importance of plant structures, systems, and components to the achievement of safety.

28332 **(NUREG—1066) Comparison of implementation of selected TMI action plan requirements on operating plants designed by Babcock & Wilcox.** Thoma, J.O. (Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Reactor Regulation). May 1984. 194p. NTIS, PC A09/MF A01 - GPO* $6.00. Order Number DE84901248.

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This report provides the results of a study conducted by the US Nuclear Regulatory Commission staff to compare the degree to which eight Babcock and Wilcox (B & W) designed licensed nuclear power plants have complied with the requirements in NUREG-0737, Clarification of TMI Action Plan Requirements. The eight licensed operating plants examined are as follows: Arkansas Nuclear One Unit 1 (ANO-1), Crystal River Unit 3, Davis Besse, Oconee Units 1, 2, and 3, Rancho Seco, and Three Mile Island Unit 1 (TMI-1). The purpose of this audit was to establish the progress of the TMI-1 licensee, General Public Utilities (GPU) Nuclear Corporation, in completing the long-term requirements in NUREG-0737 relative to the other B & W licensees examined.

28333 **(NUREG/BR—0058-Rev.1) Regulatory analysis guidelines of the US Nuclear Regulatory Commission. Revision 1.** (Nuclear Regulatory Commission, Washington, DC (USA)). May 1984. 27p. NTIS, PC A03/MF A01 - GPO*. Order Number DE84901249.

These guidelines are designed to provide a framework for structuring the analysis required to support proposed and final generic regulatory requirements. The analysis is intended to aid the staff and the Commission in determining whether to initiate a regulatory action, in selecting the preferred regulatory alternative, and in providing a coherent, understandable, and well-documented explanation of why a particular action was recommended. Making the performance of a regulatory analysis an integral part of developing a staff position on a proposed regulatory action, not as an afterthought simply to meet a procedural requirement, should result in a better and more efficiently prepared analysis. Also, use of procedures to outline the scope of the analysis could significantly aid in determining the level of effort and associated resources required to perform a regulatory analysis as well as contribute to the early identification of potential alternatives, possible consequences and information that may be needed to perform the analysis. A regulatory analysis should accompany all proposed rules and final rules which are covered by these guidelines which are forwarded for review by the Committee to Review Generic Requirements or the Deputy Executive Director for Regional Operations and Generic Requirements, or submitted for decision by the Executive Director for Operations or the Commissioners.

2108 Economics

REFER ALSO TO CITATION(S) 28429

22 NUCLEAR REACTOR TECHNOLOGY

2201 Theory And Calculation

REFER ALSO TO CITATION(S) 28286, 28353

28334 **(IKE—6-FB-7) Establishing a PWR burn-up library.** Lutz, D.C. (Institut fuer Kerntechnik und Energiewandlung e.V., Stuttgart (Germany, F.R.)). Jan 1981. 63p. (In German). NTIS (US Sales Only), PC A04/MF A01. Order Number DE84751299.

Starting out from data file ENDF/B IV /1/, a cross-section library has been established for the calculation of operating conditions in pressurized water reactors of the type used in BIBLIS B. The library includes macroscopic, homogenized 2-group cross-sections for all types of fuel elements used in this reactor, including those equipped with boron glass rods. For their calculation the previous irradiation of the fuel has been taken into consideration by approximation. Information on fuel consumption from cell burn-up calculations has been stored in a separate data file. It was designed as a base for the determination of cross sections to be used in the calculation of the incident "main-steam pipe fracture". For this library the description of cross sections as a function of the moderator status chose the water densities at 300°C/155 bar, 190°C/140 bar and 100°C/100 bar as fixed values. The burn-up library has been tested by a three-dimensional calculation for the 1sup(st) cycle of the BIBLIS B-reactor using program QUABOX /2/. This showed variances with the anticipated course concerning critically, which can be explained almost quantitatively by known deficiencies of the ENDF/b-IV library.

28335 **(KFK—3543) Fast breeder physics and nuclear core design.** Marth, W.; Schroeder, R. (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Projekt Schneller Brueter). Jul 1983. 207p. (In German). (CONF-830169—). NTIS (US Sales Only), PC A10/MF A01. Order Number DE84751330.

From Seminar on fast breeder physics and nuclear core design; Karlsruhe, F.R. Germany (18 Jan 1983).

This report gathers the papers that have been presented on January 18/19, 1983 at a seminar "Fast breeder physics and nuclear core design" held at KfK. These papers cover the results obtained within about the last five years in the r+d program and give some indication, what still has to be done. To begin with, the "tools" of the core designer, i.e. nuclear data and neutronics codes are covered in a comprehensive way, the seminar emphasized the applications, however. First of all the accuracies obtained for the most important parameters are presented for the design of homogeneous and heterogeneous cores of about 1000 MWe, they are based on the results of critical experiments. This is followed by a survey on activities related to the KNK II reactor, i.e. calculations concerning a modification of the core as well as critical experiments done with respect to re-loads. Finally, work concerning reactivity worths of accident configurations is presented: the generation of reactivity worths for the input of safety-related calculations of a SNR 2 design, and critical experiments to investigate the requirements for the codes to be used for these calculations. These papers are accompanied by two contributions from the industrial partners. The first one deals with the requirements to nuclear design methods as seen by the reactor designer and then shows what has been achieved. The latter one presents state, trends, and methods of the SNR 2 design. The concluding remarks compare the state of the art reached within DeBeNe with international achievements.

28336 (KFK—3543, pp 3-17) **Requirements concerning nuclear calculation methods and how they are to be met by a common R+D programme.** Henssen, H. Jul 1983. (In German). NTIS (US Sales Only), PC A10/MF A01. Order Number DE84751330. (CONF-830169—). TI84751330

From Seminar on fast breeder physics and nuclear core design; Karlsruhe, F.R. Germany (18 Jan 1983).

For the design of reactor cores the neutron physicist will require mainly three "instruments": Computing programmes; Core and materials data; Specialist know-how. The requirements to be met by these "instruments" can be subdivided into three complexes: Accuracy; reliability; efficiency. In the early seventies, manufacturers' requirements concerning accuracy were for the first time systematically compiled under the DeBeNe programme and compared with failure rates known at the time. This lead to relevant criteria for setting up R + D schedules for successive years. The term "reliability" means safety against systematical or sporadically occurring failures. Redundant research, routine in handling computing programmes and quality assurance thereof are some of the relevant aspects in this context. Efficiency of the methods does not only or mainly refer to the computing time required by the programmes. Simplicity of handling and avoiding superfluous manwork, in particular in calculating series of programmes of the same kind is more important. Such influences of rationalization are most important for the manufacturer. This paper shows to what extent the requirements described were met by the past R + D programme. It also indicates further research tasks that still need to be fulfilled. It finally deals with the question whether, and if so, to what extent cooperation of various partners may lead to more " harmony" in the use of identical procedures.

28337 (KFK—3543, pp 18-43) **Nuclear data: Measurements, files and cross sections.** Froehner, F.H. Jul 1983. (In German). NTIS (US Sales Only), PC A10/MF A01. Order Number DE84751330. (CONF-830169—). TI84751330

From Seminar on fast breeder physics and nuclear core design; Karlsruhe, F.R. Germany (18 Jan 1983).

With 16 figs.

The paper illustrates by means of examples the state-of-the-art in measurement and evaluation of microscopic nuclear data and the provision of adjusted cross sections for nuclear calculations. It deals in brief with: - precision measurement of resonance capture with structural materials, of fission and capture cross sections of high-level radioactive actinides by means of recently developed methods carried out on the IAK's Van de Graaff accelerator, - the evaluation of cross sections for fission and corrosion products at the ECN Petten, of actinide cross sections at the INR; the comparison with integral measurings and burnup data, - the development of theoretical nuclear methods and mathematical-statistical methods for the evaluation of microscopic nuclear data, - international cooperation, participation in the compilation of the western European-Japanese cross section library JEF (Joint Evaluated File), - group constants (method and programme development, KfKINR2), and - future work planned.

28338 (KFK—3543, pp 44-65) **Neutronics codes.** Buckel, G. Jul 1983. (In German). NTIS (US Sales Only), PC A10/MF A01. Order Number DE84751330. (CONF-830169—). TI84751330

From Seminar on fast breeder physics and nuclear core design; Karlsruhe, F.R. Germany (18 Jan 1983).

With 15 figs.

The objectives are the development, testing and cultivation of reliable, efficient and user-optimized neutron-physical calculation methods and conformity with users' requirements concerning design of power reactors, planning and analysis of experiments necessary for their protection as well as research on physical key problems. A short outline of available computing programmes for the following objectives is given: - Provision of macroscopic group constants, - Calculation of neutron flux distribution in transport theory and diffusion approximation, - Evaluation of neutron flux-distribution, - Execution of disturbance calculations for the determination reactivity coefficients, and - graphical representation of results.

28339 (KFK—3543, pp 66-83) **Homogeneous and heterogeneous reactor cores: Characteristic neutron-physical properties, critical experiments.** Helm, F. Jul 1983. (In German). NTIS (US Sales Only), PC A10/MF A01. Order Number DE84751330. (CONF-830169—). TI84751330

From Seminar on fast breeder physics and nuclear core design; Karlsruhe, F.R. Germany (18 Jan 1983).

With 3 tabs., 6 figs.

Both homogeneous and heterogeneous cores are being considered for the construction of large breeder reactors. Heterogeneous constructions present more favourable values where Na-void coefficient, breeding rate and radiation exposure of the cladding material, while other nuclear parameters, in particular Doppler effect, space and time variations of power generation are unfavourably influenced. These circumstances make it absolutely essential for optimum core design to have as accurate as possible predictions on neutron-physical parameters. Reliability of nuclear data and computing methods used therefor were verified by integral experiments carried out in cooperation with English and French partners at the ZEBRA plant in Winfrith and MASURCA in Cadarache. The evaluations carried out so far basically confirm the differences in neutron-physical properties of homogeneous and heterogeneous arrangements that has been established by calculations.

28340 (KFK—3543, pp 104-125) **Several neutron-physical aspects of modified KNK-II assemblies.** Broeders, I.; Krieg, B.; Kuesters, H.; Stein, E. Jul 1983. (In German). NTIS (US Sales Only), PC A10/MF A01. Order Number DE84751330. (CONF-830169—). TI84751330

From Seminar on fast breeder physics and nuclear core design; Karlsruhe, F.R. Germany (18 Jan 1983).

These surveys aim at designing KNK II reloads with fuel that is as prototypical as possible, i.e. mixed oxide fuel of a U-235 enrichment that is as low as possible and also at examining related neutron-physical aspects. In these reloads emphasis is also put on good experimenting conditions. Neutron-physical calculations for the examined reload cores were carried out using the three-dimensional diffusion programme D3E with Δ-Z-geometry and the AUDI 3-programme for evaluation and perturbation theory in accordance with the KfK/INR principle. The effective cross sections for absorber elements and special experimental inserts were calculated transport-theoretically by means of the KAPER 4 cell programme. The DIAMANT SN-programme was used to estimate transport effects in the calculation of neutron flux density. The lecture presents two schemes that are compared to KNK-II reactors 1 and 2 and to cores of the Japanese test reactor JOYO. Neutronphysical results for the installation of an experimental insert with a high variable linear power rating in KNK-II reload cores are dealt with in brief.

28341 (KFK—3543, pp 126-147) **KNK-II reactor: Reload experiments in SNEAK-11 reactor.** Moellendorff, U. v. Jul 1983. (In German). NTIS (US Sales Only), PC A10/MF A01. Order Number DE84751330. (CONF-830169—). TI84751330

From Seminar on fast breeder physics and nuclear core design; Karlsruhe, F.R. Germany (18 Jan 1983).

With 2 tabs., 11 figs.

Three reload cores originally planned for the KNK-II reactor were examined at the Karlsruhe Fast Zero Energy Assembly (SNEAK-reactor) under the denomination of SNEAK 11. Two of them were assembled in two versions each: with drawn absorber rods, i.e. corresponding in its criticality with spent power reactors, which is the normal SNEAK assembly; and with absorbers half-inserted as with new cores. The latter of the two in closer to the actual core design task, yet it causes great calculation problems, because they need to be mainly three-dimensional. Main points of the measuring programme included: - critical sizes (with drawn absorbers) or critical insertion depth of the KNK control/scram absorbers, - fission rate distribution, - sodium loss reactivity, - absorption values of control/scram rods and secondary shutdown units.

28342 (KFK—3543, pp 148-166) **Reactivity worths of accident configurations.** Henneges, G. Jul 1983. (In German). NTIS (US Sales Only), PC A10/MF A01. Order Number DE84751330. (CONF-830169—). TI84751330

From Seminar on fast breeder physics and nuclear core design; Karlsruhe, F.R. Germany (18 Jan 1983).

With 3 tabs., 9 figs.

Reactivity coefficients and kinetic parameters are required for the safety analysis of LMFBR-type reactors. Such neutron-physical parameters were set up at the INR by complicated three-dimensional diffusion calculations for homogeneous and heterogene-

ous SNR-2 core (HOM 1 and HET 1 respectively). Besides elaborating theorems on coefficients required for the safety analysis with SAS 3 D and SIMMER, reactivity worths of accident configurations were measured and SNEAK-12 programme. Results from the experiments are being compared to diffusion and transport calculations.

28343 (KFK—3543, pp 167-203) **SNR-2 reactor: Design, state, trends and methods.** Wehmann, U. Jul 1983. (In German). NTIS (US Sales Only), PC A10/MF A01. Order Number DE84751330. (CONF-830169—). TI84751330

From Seminar on fast breeder physics and nuclear core design; Karlsruhe, F.R. Germany (18 Jan 1983).

Starting at the situation in 1975, the basic ideas that have lead from the reference care HOM 1 to today's basic core are shown. The use of the various methods is discussed by means of typical aspects of design: BRUST for parameter studies (e.g.: rod cross sections and the influence of burnup on cycle costs), RZ-diffusion for comparative studies with a high degree of accuracy required (e.g.: the influence of rod cross sections on reactivity coefficients), 3-dimensional diffusion (e.g.: studies aiming at reducing the number of absorbers, 3-d burnup of the basic care), 3-d transport (e.g.: ensuring of absorber efficiencies calculated by DEGEN). Further possible design modifications for the SNR-2 reactor and related design work are discussed. In addition to Dr. Heussen's lecture, the present state-of-the-art in design methods and improvements that may be required are dealt with.

28344 (PB—84-157023) **Application of the program LOUHI82 to reactor neutron spectrum unfolding.** Sandberg, J.V. (Helsinki Univ. of Technology, Espoo (Finland). Dept. of Technical Physics). 15 Jul 1983. 69p. (TKK-F-A—524). NTIS, PC E04/MF E01.

The use of the least-squares unfolding program LOUHI82 is exemplified with applications to reactor neutron spectrum unfolding. The cases considered include unfolding a Triga reactor spectrum from multicomponent activation detector measurements and sensitivity studies using generated activities. The data distributed in the REAL-80 intercomparison were used to unfold the thermal ORR and the fast YAYOI reactor spectra. The results were physically acceptable and in fairly good agreement with the results of other unfolding programs.

2202 Components And Accessories

REFER ALSO TO CITATION(S) 28393, 28824, 28825, 28826

28345 (CEA-CONF—6856) **European contribution to PISC 1 program - alternate US PISC procedure.** Saglio, R. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France)). Jun 1983. 4p. (CONF-830607—31). NTIS (US Sales Only), PC A02/MF A01. Order Number DE84750646.

From American Society of Mechanical Engineers pressure vessel and piping conference; Portland, OR, USA (19 Jun 1983).

The PISC trials were primarily conducted to assess the capability of the ultrasonic procedure prepared by the Pressure Vessel Research Committee and based on the ASME Code Section XI (1974) to detect, locate and size flaws or discontinuities in welds in heavy section steel. However, in addition to the results using this procedure to examine three test plates participating inspection teams were invited to present, the results of an inspection using alternative ultrasonic techniques. Because of the small numbers of teams giving results for a given class of procedures neither a defect detection probability nor a correct rejection/acceptance probability could be estimated. However suitable parameters related to detection and rejection were defined to give an indication of the trend in the performance of a group of alternative procedures as compared with the PISC procedure. The criterion used for rejection/acceptance of defects was taken from the ASME Code. Many of the teams giving results for alternative procedures would not use this criterion in practice. Its use in this analysis was a symbolic one to illustrate trends.

28346 (CEA-CONF—6976) **Calculation of the wall pressure field generated on a group of building by an external explosion.** Aillaud, P.; Verpeaux, P.; Barbe, B.; Parot, J.M. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France); CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France)). Aug 1983. 14p. (CONF-830805—81). NTIS (US Sales Only), PC A02/MF A01. Order Number DE84750636.

From 7. international conference on structural mechanics in reactor technology; Chicago, IL, USA (22 Aug 1983).

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The aim is to work out a tri-dimensional code calculating the over-pressure distribution on any structure when an air shock waves arrives specially in the case of geometry providing multiples waves reflection. The computer code ZEPHIR was written for the Huyghens-Helmotz (or Kirchhoff) equation with the assumption that the phenomena agrees with the accoustic laws. An integral formulation of this relation leads infinite tridimensional problems to a bidimensional one on a surface S limiting the real D. The obtained equation gives the pressure at a point M_0 of S and at the time t_0 only from the source and the pressures of the other points of S at the past time. The surface S is discretized with triangular elements by means of an automatic computer code COCO of CEASEMT system. In the first approach the value of the pressure has been taken at nodes of the mesh and a direct resolution of the equation has been done. Difficulties with computation of curvature radius and singular kernel within the integral lead to replace the S surface by the polyedre constituted by the mesh and to compute the pressure at the gravity center of the triangular elements. But the second approach does not eliminate the time instability in some geometries. In order to eliminate instability the pressure is calculated with interpolation between several time steps. This solution is efficient and complete qualification obtained.

28347 (CEA-CONF—6978) **Strategy to compute plastic post-buckling of structures.** Combescure, A. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France)). Aug 1983. 11p. (CONF-830805—77). NTIS (US Sales Only), PC A02/MF A01. Order Number DE84750616.

From 7. international conference on structural mechanics in reactor technology; Chicago, IL, USA (22 Aug 1983).

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The paper gives a general framework to the different strategies used to compute the post-buckling of structures. Two particular strategies are studied in more details and it is shown how they can be applied in the plastic regime. All the methods suppose that the loads F are proportional to a simple parameter lambda; more precisely: eq (1) F = lambda F_0. The paper shows how these methods can be implemented in a very simple way. In the elastic case we show the application of the method to the calculation of post buckling response of a clamped arch. The method is also applied to a very simple case of two bars which can be calculated analytically. In the plastic range, the method is applied to the post-buckling of an imperfect ring which can be calculated analytically. Another example is the comparison of the comparison of the computed post-buckling of a thin cylinder under axial compression, and of the experimental behavior on the same cylinder. The limitation of these types of strategies are also mentionned and the physical signifiance of calculations in the post-buckling regime are discussed.

28348 (CEA-CONF—6980) **Friction finite elements numerical analysis of piping systems: theory and applications.** Millard, A.; Prost, J.M.; Ricard, A. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France); Societe Franco-Americaine de Constructions Atomiques (FRAMATOME), 92 - Courbevoie (France)). Aug 1983. 13p. (CONF-830805—86). NTIS (US Sales Only), PC A02/MF A01. Order Number DE84750667.

From 7. international conference on structural mechanics in reactor technology; Chicago, IL, USA (22 Aug 1983).

Contact problems are often encountered in civil engineering applications and specially in nuclear piping systems: pipe whip, impact on supports in case of seismic analysis, non linear calculations of thermal expansions, etc.. Most of the time, the geometrical non linearity of the contact problems is coupled with a material

non linearity due to the contact associated with the state of the surfaces in contact. For the sake of simplicity, the classical Coulomb friction has been assumed, which leads to frictional sliding when the tangential force modulus reaches a fraction of the normal compression force. In order to account for such a model in a beam type finite element program, a special element has been developped. It is formulated in terms of genezalized stresses: axial forces and shear forces in two orthogonal direction. Below the sliding threshold, the element has only axial and shear elastic rigidities in compression. When the sliding threshold is reached, a perfectly plastic behavior is assumed. The element can be used together with unilateral conditions for example in order to calculate the pipe whip impact on a structure. This element has been implemented in the piping analysis TEDEL program of the CEASEMT finite element system. In the second part of this paper, simple tests are presented.

28349 **(CEA-CONF—6981) Calculations methodology of the instabilities for thin shell structures.** Brochard, J.; Combescure, A.; Deniau, J.L.; Payre, J.P.; Perona, M. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France)). Aug 1983. 9p. (CONF-830805—87). NTIS (US Sales Only), PC A02/MF A01. Order Number DE84750668.

From 7. international conference on structural mechanics in reactor technology; Chicago, IL, USA (22 Aug 1983).

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This paper presents a calculation methodology of the instabilities applicable for the design of axisymmetric thin structures against buckling risk. The application case discussed here is a tank loaded by external pressure and seismic effects. The calculations have been made by the Finite Element Method with the CASTEM System Codes. In a first step, the structure is supposed perfect and the calculations are made with an axisymmetric thin shell model. The axisymmetric model gives good results for high circumferential modes. In the case of earthquake, simulated by lateral loads, complementary results about shear buckling modes are obtained using a three dimensional model. However, the real structure is not perfect but includes necessarily initial imperfections. Consequently, in a second step, the study consists in determining the critical load reduction due to the introduction of an initial imperfection.

28350 **(CEA-CONF—6985) Thermal transient analysis in a nozzle with an inner thermal baffle.** Corsi, F.; Goldstein, S.; Joly, J. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France)). Aug 1983. 11p. (CONF-830805—82). NTIS (US Sales Only), PC A02/MF A01. Order Number DE84750637.

From 7. international conference on structural mechanics in reactor technology; Chicago, IL, USA (22 Aug 1983).

The paper presents an example of application of the Delfine code in a non linear thermal transient study. The code is part of finite elements CASTEM System developed in CEA Saclay. The study refers about the analysis of the thermal history of a structure that is subjected to thermal exchange with a fluid flowing in forced convection in open loop. In the first part it's given the approach used in the computer program to solve the problem and then the experimental theoretical study of a plant component. The study presents the analysis of the temperature history of a nozzle provided by an inner thermal baffle subjected to cold thermal shocks from the initial temperature (approximately 540°C) with an about 15°C/sec thermal gradient. The used instrumentation includes thermocouples to measure the temperature versus time at various points along the axial length of the nozzle. All instrumentation was put on the outside surface of the structure. To uniform the temperature at the initial action point of the thermal baffle a little flow of sodium passes in the angular interspace between the nozzle and the thermal baffle. The by-pass sodium flow is not costant and also the inlet Na temperature is variable in time. The calculation of the sodium flow rate between the nozzle and the thermal baffle is made by an ad-hoc finite differences code. The calculation of the fluid temperature is made in transitory regime appreciating the cooling temperature rate of Na in contact with the structural components that it skins and its calorific capacity. The theoretical-experimental comparison of the trend of temperature in time at different heights shows that there is a very good identity for the different points of the structure.

28351 **(CONF-840647—9) Hydrodynamic mass.** Chung, H.; Chen, S.S. (Argonne National Lab., IL (USA)). 1984. Contract W-31-109-ENG-38. 59p. NTIS, PC A04/MF A01; 1; GPO Dep. Order Number DE84009185.

From ASME pressure vessel and piping conference; San Antonio, TX, USA (17 Jun 1984).

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Many structural components contain, or are submerged in, a fluid. The fluid moving with a vibrating structure has an important effect on the dynamics of the structure, particularly on its natural frequencies. The effect of the fluid on natural frequencies can be accounted for using the hydrodynamic mass associated with the structure. This paper provides formulas, graphs, and computer programs for calculating hydrodynamic mass.

28352 **(EGG-EA—6550) Assessment of structural computer code implementation of PVRC recommended piping damping values.** Ware, A.G. (EG and G Idaho, Inc., Idaho Falls (USA)). Mar 1984. Contract AC07-76ID01570. 35p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE84011886.

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A task group of the Pressure Vessel Research Committee of the Welding Research Council has recommended that structural damping for seismic analyses of piping systmes be modified from the present constant damping to allow higher damping values at low response frequencies. This Technical Development Program project evaluates the implementation of the proposed change on the INEL structural computer codes. For response spectrum analyses and time history modal superposition analyses, the most commonly used seismic techniques, the proposed changes can be easily carried out. Appropriate methods are described in this report. For the time history direct integration method of solution, exact implementation is impossible, and choosing the appropriate Rayleigh constants in order to avoid excessive over- or underconservatism in damping values will be difficult. However, this type of solution method is rarely used in seismic structural analyses.

28353 **(Juel—1866) ACFA - a versatile activation code for coolant and structural materials.** Brockmann, H.; Ohlig, U. (Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.). Inst. fuer Reaktorentwicklung). Sep 1983. 54p. NTIS (US Sales Only), PC A04/MF A01. Order Number DE84751334.

The ACFA code calculates the neutron-induced activation, afterheat, transmutation, gas production, biological hazard potential, and activation gamma ray spectra in the components of a nuclear system. The quantities of interest may be computed by spatial interval and zone or only by zone of the system considered. To calculate the transmutation coefficients for the neutron-induced reactions the code uses multigroup activation cross sections and space-dependent multigroup neutron fluxes in one- or two-dimensional geometry. The neutron reaction types incorporated in the code are: (n,n'), (n,2n), (n,γ), (n,p), (n,α), (n,n'p), (n,n'α)sub(,) (n,t), (n,3n), (n,He-3), (n,d), and (n,n'd) considering both reactions to the ground state and to isomeric states. The code uses a variable dimensioning technique to adapt the core data storage requirements to the particular problem considered and uses the FIDO input system to read the input data. The numerical methods for establishing and solving the decay chain equations are taken from the ORIGEN code. To test the ACFA code and the nuclear data libraries used, the activation, composition change, and gas production in the first wall of the UWMAK-I fusion reactor are calculated. The results of the activation calculation are compared with earlier results of the University of Wisconsin Fusion Study Group.

28354 **(NUREG—0975-Vol.2) Compilation of contract research for the Materials Engineering Branch, Division of Engineering Technology. Annual report for FY 1983. Vol.2.** (Nuclear Regulatory Commission, Washington, DC (USA). Div. of Engineering Technology). Mar 1984. 310p. NTIS, PC A14/MF A01 - GPO* $7.50. Order Number DE84901057.

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This report presents summaries of the research work performed during Fiscal Year 1983 by laboratories and organizations

under contracts administered by the NRC's Materials Engineering Branch, Office of Nuclear Regulatory Research. Each contractor has written a more complete and detailed annual report of their work which can be obtained by writing to NRC. The contractor reports are organized into the major areas of concern to Primary System Integrity, which is the main focus for the branch's research. These areas are: Vessel and Piping Fracture Mechanics; Pressure Vesel Surveillance Dosimetry; Steam Generators, Aging, and Environmental Cracking; and Non-Destructive Examination. The research programs reported provide information on the overall program objectives, a more limited scope of work for FY 1983, a technical description of the year's work, and a brief forecast of the plans for continuing work.

28355 **(UNI-SA—122) Collection of micron-sized particles at high velocities in HGMS.** Leitermann, W.; Friedlaender, F.J.; Gerber, R.; Hwang, J.Y.; Emory, B.B. (UNC Nuclear Industries, Inc., Richland, WA (USA)). 30 Mar 1984. Contract AC06-76RL01857. 13p. (CONF-8404132—1). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE84009699.

From IEEE international magnetic conference; Hamburg, F.R. Germany (30 Apr 1984).

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The collection of micron-sized, strongly magnetic particles is studied at flow velocities ranging from 21 cm/s to 73 cm/s in different collector arrangements of a model high gradient magnetic separator. The buildup of Fe_3O_4 particles is compared for different flow velocities, applied fields and particle concentrations for 5 different collector geometries. It is found that the longitudinal and the transverse configuration of parallel nickel wires show the largest buildup, closely followed by steel meshes in the transverse arrangement and the parallel wires in the axial configuration, while the longitudinal grid has somewhat less particle buildup. At low particle concentrations an increased flow velocity leads to increased buildup, while an increase of the magnetic field has hardly any effect.

28356 **Triaxial concrete constitutive models and their application to the nonlinear analysis of nuclear plant structures.** Anderson, C.A.; Butler, T.A.; Fugelso, L.E. (Los Alamos National Laboratory, Los Alamos, NM). pp 49-74 of Nonlinear numerical analysis of reinforced concrete. Schwer, L.E. New York, NY; A.S.M.E. (1982). (CONF-821101—).

From ASME winter annual meeting (Engineering applications of laser velocimetry/published in ASME Jr. Fluid Engineering); Phoenix, AZ, USA (14 Nov 1982).

At the Los Alamos National Laboratory the finite element method has been used to predict the response of several types of concrete structures to severe accident conditions that could occur at nuclear power plants. Both prestressed and normally reinforced concrete structures have been analyzed to determine their responses to seismic events and quasistatic and dynamic pressure loads. Structures analyzed include concete containment buildings, prestressed concrete reactor vessels, and concrete shear walls. Finite element models of the structures have been developed with both the NONSAP-C and ADINA computer codes. Because the purpose of our analyses has generally been to determine failure loads and modes of failure, calculations are carried out well into the nonlinear range. Therefore, the computer codes have to include concrete constitutive models that treat concrete cracking and crushing and other nonlinear effects. In the paper we describe the concrete constitutive models and their application and discuss the shortcomings of the models in the structural simulations. We also discuss the numerical procedures used in our analyses and suggest some improvements that should make the analysis of concrete structures numerically stable to the point of failure. In several of the analyses presented, we compare computed response with measured response through at least the linear range. Our analysis of the shear wall response includes comparisons with test data to failure.

2203 Fuel Elements

28357 **(CEA-CONF—6977) Seismic analysis of a PWR 900 reactor: study of reactor building with soil-structure interaction and evaluation of floor spectra.** Gantenbein, F.; Aguilar, J. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France); Compagnie Internationale de Services en Informatique (CISI), Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France)). Aug 1983. 11p. (CONF-830805—78). NTIS (US Sales Only), PC A. Order Number DE84750617.

From 7. international conference on structural mechanics in reactor technology; Chicago, IL, USA (22 Aug 1983).

Paper copy only, copy does not permit microfiche production.

The purpose of this paper is the evaluation of seismic response and floor spectra for a typical PWR 900 reactor building with respect to soil-structure interaction for soil stiffness). The typical PWR 900 reactor building consists of a concrete cylindrical external building and roof dome, a concrete internal structure (internals) on a common foundation mat as illustrated. The seismic response is obtained by SRSS method and floor spectra directly from ground spectrum and modal properties of the structure. Seismic responses and floor spectra computation is performed in the case of two different ground spectra: EDF spectrum (mean of oscillator spectra obtained from 8 californian records) normalized to 0.2 g, and DSN spectrum (typical of shallow seism) normalized to 0.3 g. The first section is devoted to internals' modelisation, the second one to the axisymmetric model of the reactor, the third one to the seismic response, the fourth one to floor spectra.

28358 **(LBL—16893) Release of volatile fission products from UO_2.** Prussin, S.G.; Olander, D.R.; Goubeault, P.; Bayen, D. (Lawrence Berkeley Lab., CA (USA)). Oct 1983. Contract AC03-76SF00098. 8p. (CONF-840701—3). NTIS, PC A02/MF A01; GPO Dep. Order Number DE84004633.

From Topical meeting on fission product behavior and source term research; Snowbird, UT, USA (15 Jul 1984).

In our experiments, post-irradiation anneal of lightly-irradiated UO_2 was used to measure the release kinetics of the volatile fission products Xe, I, and Te. The fraction of a particular fission product retained in a specimen was measured by gamma-ray spectroscopy before and following an anneal.

28359 **(NUREG/CR—3335) Data summary report for fission product release test HI-3.** Osborne, M.F.; Lorenz, R.A.; Norwood, K.S.; Travis, J.R.; Webster, C.S. (Oak Ridge National Lab., TN (USA)). Mar 1984. Contract AC05-84OR21400. 68p. (ORNL/TM—8793). NTIS, PC A04/MF A01; 1 - GPO; GPO Dep. Order Number DE84010352.

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The third in a series of high-temperature fission product release tests was conducted for 20 min at 2000°C in flowing steam. The test specimen, a 20-cm-long section of H.B. Robinson fuel rod that had been irradiated to ~ 25,200 MWd/t, was heated in an induction furnace in a hot cell. Posttest examination showed that the Zircaloy cladding had melted, causing extensive disintegration of the UO_2 fuel and formation of molten phases that appeared to be rich in uranium. Analyses of test components revealed very high fractional releases of ^{85}Kr (59.0%), ^{137}Cs (58.8%), and ^{129}I (35.4%). The releases of ^{125}Sb and /sup 110m/Ag, however, were much less than those observed in test HI-2 at 1700°C, perhaps as a result of lower steam flow rate in test HI-3. The extent of aerosol formation, as evidenced by mass of material collected on filters, was similar in the two tests.

2204 Control Systems

28360 **(CONF-840286—1) Validation of plant-wide data and fault identification at steady-state.** Tzanos, C.P. (Argonne National Lab., IL (USA)). 1984. Contract W-31-109-ENG-38. 12p. NTIS, PC A02/MF A01; GPO Dep. Order Number DE84011735.

From Workshop on large plant control systems; Oak Ridge, TN, USA (14 Feb 1984).

This paper presents a methodology of data validation and fault identification, based on analytic redundancy, for steady-state plant operation. This work differs from previously reported work on analytic redundancy in that validation of all the main parameters of the plant heat-transport loops is sought by using plant-wide instrument information. An LMFBR plant is used as a reference, and validation of the following plant parameters is considered: reactor power (Q), reactor inlet and outlet coolant temperatures (T/sub IC/ and T/sub OC/, respectively), intermediate heat exchanger (IHX) inlet and outlet secondary coolant temperatures (T/sub IS/, T/sub OS/), steam generator feedwater temperature (T/sub w/), steam temperature (T/sub S/) and pressure (P/sub s/) as well as primary, intermediate, and feedwater flows (G/sub p/, G/sub I/, G/sub w/).

28361 (CONF-840614—7) Reactor shutdown system unavailability improvement by using a system of continuous data validation. Tzanos, C.P. (Argonne National Lab., IL (USA)). 1984. Contract W-31-109-ENG-38. 6p. NTIS, PC A02/MF A01; GPO Dep. Order Number DE84005428.

From Annual meeting of the American Nuclear Society; New Orleans, LA, USA (3 Jun 1984).

Objective is to show that the unavailability of the scram initiation function of the reactor shutdown system (RSS) can be significantly reduced by using a system of continuous data validation and manual scram as a redundant and diverse means of cutting off the power supply to the control rod drives. A continuous data validation system that can be used for that purpose is currently under development at Argonne National Laboratory and is envisioned to operate as follows. Direct sensor measurements of safety-important parameters are fed to the system every few seconds. These direct measurements and analytic measurements generated in real-time from an analytic plant model are compared for consistency. Through this comparison instrumentation and other plant component failures can be identified, and validated values of safety-important parameters can be generated even in the presence of a significant number of instrumentation common-cause failures.

28362 (CONF-840614—44) Methodology for validation of safety parameters and fault detection and isolation. Tzanos, C.P. (Argonne National Lab., IL (USA)). 1984. Contract W-31-109-ENG-38. 5p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE84005538.

From Annual meeting of the American Nuclear Society; New Orleans, LA, USA (3 Jun 1984).

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In this paper a methodology for instrument data validation as well as fault detection and isolation, based on analytic redundancy, is presented. This work differs from previously reported work on analytic redundancy in that validation of all the main parameters of the plant heat transport loops is sought by using plant-wide instrument information. An LMFBR plant is used as a reference, and validation of the following plant parameters is considered: reactor power (Q), reactor inlet (T/sub IC/) and reactor outlet (T/sub OC/) coolant temperatures, intermediate heat exchanger (IHX) inlet (T/sub IS/) and outlet (T/sub OS/) secondary coolant temperatures, steam generator feedwater temperature (T/sub w/), steam temperature (T/sub s/) and pressure (P/sub s/), as well as primary (G/sub p/), intermediate (G/sub I/), and feedwater (G/sub w/) flow. In this paper, only validation at steady state conditions will be discussed.

28363 (KFK—3543, pp 84-103) Efficiency of control rods. Giese, H. Jul 1983. (In German). NTIS (US Sales Only), PC A10/MF A01. Order Number DE84751330. (CONF-830169—). TI84751330

From Seminar on fast breeder physics and nuclear core design; Karlsruhe, F.R. Germany (18 Jan 1983).

With 2 tabs., 8 figs.

The control rod experiments carried out at the English zero energy assembly ZEBRA under the UK-DeBeNe Research Cooperation Programme BIZET are the basis for now used measuring and evaluation methods described herein. The subsequent comparison with results from corresponding measurements in various SNEAK assemblies reflects very well the present state of anticipation of control rod values.

28364 (NUREG/CR—3696) Potential human factors deficiencies in the design of local control stations and operator interfaces in nuclear power plants. Hartley, C.S.; Levy, I.S.; Fecht, B.A. (Pacific Northwest Lab., Richland, WA (USA)). Apr 1984. Contract AC06-76RL01830. 130p. (PNL—4952). NTIS, PC A07/MF A01; 1 - GPO $5.50; GPO Dep. Order Number DE84011673.

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The Pacific Northwest Laboratory has completed a project to identify human factors deficiencies in safety-significant control stations outside the control room of a nuclear power plant and to determine whether NUREG-0700, Guidelines for Control Room Design Reviews, would be sufficient for reviewing those local control stations (LCSs). The project accomplished this task by first, reviewing existing data pertaining to human factors deficiencies in LCSs involved in significant safety actions; second, surveying LCSs environments and design features at several operating nuclear power plants; and third, assessing the results of that survey relative to the contents of NUREG-0700.

28365 (NUREG/CR—3725) Nuclear power plant simulators for operator licensing and training. Part I. The need for plant-reference simulators. Part II. The use of plant-reference simulators. Rankin, W.L.; Bolton, P.A.; Shikiar, R.; Saari, L.M. (Battelle Human Affairs Research Center, Seattle, WA (USA)). May 1984. Contract AC06-76RL01830. 120p. (PNL—5049; BHARC—400/84/006). NTIS, PC A06/MF A01 - GPO $5.00; GPO Dep. Order Number DE84012059.

Part I of this report presents technical justification for the use of plant-reference simulators in the licensing and training of nuclear power plant operators and examines alternatives to the use of plant-reference simulators. The technical rationale is based on research on the use of simulators in other industries, psychological learning and testing principles, expert opinion and user opinion. Part II discusses the central considerations in using plant-reference simulators for licensing examination of nuclear power plant operators and for incorporating simulators into nuclear power plant training programs. Recommendations are presented for the administration of simulator examinations in operator licensing that reflect the goal of maximizing both reliability and validity in the examination process. A series of organizational tasks that promote the acceptance, use, and effectiveness of simulator training as part of the onsite training program is delineated.

28366 (PB—84-160886) Self tuning control for systems employing feedforward. Allidina, A.Y.; Hughes, F.M.; Tye, C. (Manchester Univ. Inst. of Science and Technology (UK). Control Systems Centre). Sep 1981. 36p. NTIS, PC E04/MF E04.

An analysis was formulated for the application of self-tuning to a system incorporating feedforward control. The self-tuning controller that was considered minimizes a cost function which incorporates system output, control input, disturbance input and setpoint variations. Techniques were developed which enabled the required steady state and dynamic performance to be achieved by automatic adjustment of the disturbance weighting polynomial of the cost function. For the case of dynamic performance, the concept of applying frequency response criteria to the determination of weighting polynomial was introduced; this provides dynamic filtering in the feedforward loop. The capabilities of self-tuning feedforward control and the effectiveness of the techniques proposed were demonstrated by their successful application to the control of a nuclear reactor.

28367 (PB—84-161033) Use of frequency response criteria in self tuning controller cost function specification. Papaionnou, D.; Hughes, F.M.; Allidina, A.Y. (Manchester Univ. Inst. of Science and Technology (UK). Control Systems Centre). 1983. 32p. NTIS, PC E04/MF E04.

The generalized minimum variance method provides a very flexible approach to self tuning control. Although there is great scope for defining desired system performance it is difficult to determine the cost function needed to provide it. When commissioning a self tuning controller, therefore, in the likely event that the original cost function does not provide an entirely satisfactory

overall control performance, some guidance on how to adjust the cost function is needed. This paper shows how system frequency response characteristics can identify the required changes needed in the controller, and presents a technique that enables a more suitable cost function, which will provide desired frequency response characteristics, to be directly determined as part of the commissioning procedure. The benefits that the technique can provide are demonstrated by its application to a self tuning temperature control loop on a research nuclear reactor.

28368 **Development of an extended range start-up monitor (ERSM) for boiling water reactions.** Glesius, F.L.; Hammer, M.F.; Kroon, J.C.; Myrabo, A.L. (Reuter-Stokes, Inc., 18530 S. Miles Parkway, Cleveland, Ohio 44128). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Nuclear Science;* **31**: No. 1, 738-792(Feb 1984). (CONF-831015—).

From Nuclear science symposium; San Francisco, CA, USA (19 Oct 1983).

The existing in-core instrumentation in a BWR currently performs important reactor safety functions. To avoid interfering with these functions, a new fixed Wide Range Flux Monitor (WRFM) has been designed to cover the range of 10^{-6}% to 100% full power with a single assembly. Each WRFM is designed with four fission detectors axially spaced along the fuel in an assembly dimensionally identical to an LPRM assembly. The four fission detectors within each WRFM are of two types. Two detectors separated axially above the core midplane are fission counters with regenerative (U 234/U 235) coatings for long life. Two power range fission chambers are positioned below core midplane. They are also provided with a regenerative coating and are identical to those used in an LPRM. Overlap between the source/intermediate range detectors and the power range detectors is achieved; the technical challenge lies in their miniaturization. Presently, prototypic detectors are undergoing reactor testing, and two assemblies will be installed in a power reactor in early 1984.

28369 **Computerized automatic tip scanning operation.** Nishikawa, K.; Fukushima, T.; Nakai, H.; Yanagisawa, A. (Power Generation Control Systems Department Fuchu Works, TOSHIBA Corporation 1-Toshiba-cho, Fuchu-shi, Tokyo, Japan). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Nuclear Science;* **31**: No. 1, 876-878(Feb 1984). (CONF-831015—).

From Nuclear science symposium; San Francisco, CA, USA (19 Oct 1983).

In BWR nuclear power stations the Traversing Incore Probe (TIP) system is one of the most important components in reactor monitoring and control. In previous TIP systems, however, operators have suffered from the complexity of operation and long operation time required. The system presented in this paper realizes the automatic operation of the TIP system by monitoring and driving it with a process computer. This system significantly reduces the burden on customer operators and improves plant efficiency by simplifying the operating procedure, augmenting the accuracy of the measured data, and shortening operating time. The process computer is one of the PODIA (Plant Operation by Displayed Information Automation) systems. This computer transfers control signals to the TIP control panel, which in turn drives equipment by microprocessor control. The process computer contains such components as the CRT/KB unit, the printer plotter, the hard copier, and the message typers required for efficient man-machine communications. Its operation and interface properties are described.

28370 **Nuclear system test simulator.** Dennis, U.E.; Sawyer, S.D. (G.E. Company, 175 Curtner Ave., San Jose, CA 95125). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Nuclear Science;* **31**: No. 1, 853-857(Feb 1984). (CONF-831015—).

From Nuclear science symposium; San Francisco, CA, USA (19 Oct 1983).

The design of a microcomputer based line of test instruments used to check out nuclear systems under real time simulation is presented. To reduce both test time and the chance for technician error, special emphasis was given in the design to the programming of test functions and the inclusion of operating aids. The first application of this instrument, checkout of a BWR/6 Rod Control and Information System, is illustrated.

28371 **Critical function monitoring system algorithm development.** Harmon, D.L. (Combustion Engineering, Inc., Windsor, CT). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Nuclear Science;* **31**: No. 1, 862-867(Feb 1984). (CONF-831015—).

From Nuclear science symposium; San Francisco, CA, USA (19 Oct 1983).

Accurate critical function status information is a key to operator decision-making during events threatening nuclear power plant safety. The Critical Function Monitoring System provides continuous critical function status monitoring by use of algorithms which mathematically represent the processes by which an operating staff would determine critical function status. This paper discusses in detail the systematic design methodology employed to develop adequate Critical Function Monitoring System algorithms.

28372 **A new start-up range neutron monitor.** Benson, M.R.; Sawyer, S.D. (G.E. Company, 175 Curtner Ave., San Jose, CA 95125). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Nuclear Science;* **31**: No. 1, 868-875(Feb 1984). (CONF-831015—).

From Nuclear science symposium; San Francisco, CA, USA (19 Oct 1983).

In the early 1960's General Electric began producing a line of radiation monitoring equipment known as Integrated Nuclear Measurement and Control (INMAC). Recent advances in technology, especially in the area of microprocessors, now allows improved performance in the same physical package size. This paper describes a new family of radiation monitoring equipment known as Nuclear Measurement Analysis and Control (NUMAC). In these instruments all essential logic and timing are implemented through the use of Microcomputer cards. In order to provide a high assurance of operability, an optional microprocessor controlled Self Test System may be incorporated. The Self Test System continuously checks operability of all safety related functions. Other design features include highly modularized construction, an enhanced operator interface and upwards compatibility with present and future General Electric instrumentation and control products. scheduled for the third quarter of 1984. This paper describes the requirements and design of the NUMAC line with emphasis on the Source Range Monitor (SRM).

28373 **A computer-controlled Travelling Flux Detector system for CANDU reactors.** Hall, D.S.; Shinmoto, S. (Atomic Energy of Canada Limited Chalk River Nuclear Laboratories, Chalk River, Ontario). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Nuclear Science;* **31**: No. 1, 749-753(Feb 1984). (CONF-831015—).

From Nuclear science symposium; San Francisco, CA, USA (19 Oct 1983).

A transportable Travelling Flux Detector (TFD) system has been developed for use on the NRU research reactor at Chalk River as a first step in developing a TFD system for use on CANDU reactors. The system, which consists of a miniature fission chamber on a motorized winch, is used to calibrate self-powered flux detectors installed in the reactor, and to provide flux profiles. Recently the system has been upgraded to facilitate its use on a power reactor. In the upgraded system, control and data acquisition are handled by micro-computers. This paper describes the new TFD system and presents some of the results obtained on the NRU reactor. Potential applications to power reactors and alternate uses of the system are also discussed.

28374 **Testing of a prototype PWR design gamma thermometer for use as a local power monitor in the thimble tube of a nuclear reactor.** LeVert, F.E.; Bell, D.L.; Kress, R.L. (Technology for Energy Corporation One Energy Center, Pellissippi Parkway Knoxville, Tennessee 37922). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Nuclear Science;* **31**: No. 1, 754-756(Feb 1984). (CONF-831015—).

From Nuclear science symposium; San Francisco, CA, USA (19 Oct 1983).

Out-of-pile tests were performed on a 0.185-in. OD gamma thermometer (GT) designed for insertion in existing thimble tubes of W pressurized water reactors (PWR). The experimental measurements were conducted with the GT inserted in a simulated thimble tube. The measurements were performed to examine the effect on the sensitivity, response time, and repeatability of the GT output signal when surrounded by an air- and a water-filled thimble tube with random and controlled physical contact between the two units. The results showed that the linearity of the instrument is not affected when operated in an airor water-filled thimble tube. However, the response time of the GT to a step change in power increased from 9 s to about 30 s for water and dry thimble tube conditions respectively. Results are also presented which show that the sensitivity, mV/W/cm^3, of the GT with and without controlled physical contact between the inner surface of the simulated thimble tube and the outer surface of the GT did not vary significantly.

28375 **An analytical response model of neutron sensors used in reactor instrumentation.** Behbahani, A.; Miller, D.W. (The Ohio State University Nuclear Engineering Program 206 W. Eighteenth Avenue Columbus, Ohio 43210). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Nuclear Science;* **31**: No. 1, 743-748(Feb 1984). (CONF-831015—).

From Nuclear science symposium; San Francisco, CA, USA (19 Oct 1983).

An analytical model of neutron sensors of the type used in nuclear reactor instrumentation was developed for the purpose of identifying physical phenomena important to dynamic response and degradation, and for relating the transient response to radiation with the response to high voltage bias transients. The model was experimentally confirmed using Bremsstrahlung X-ray radiation transients with less than 10 nanosecond rise time.

28376 **Position-sensitive fission counter for in-core flux profile monitoring.** Kopp, M.K.; Guerrant, G.C.; Harter, J.A.; Valentine, K.H. (Instrumentation and Controls Division Oak Ridge National Laboratory Oak Ridge, Tennessee 37831, USA). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Nuclear Science;* **31**: No. 1, 733-737(Feb 1984). (CONF-831015—). Contract W-7405-ENG-26.

From Nuclear science symposium; San Francisco, CA, USA (19 Oct 1983).

A prototype model of a position-sensitive fission counter (PSFC) was developed for power-range flux profile monitoring in light-water reactor cores. The flux profile is measured by delay-line position encoding and time interval decoding of individual fission pulses from 11 small fission counters incorporated along a coaxial transmission line. Significant improvements over currently used flux profile monitors are the 33-cm spatial resolution of the 3.5-m-long PSFC and the requirement for only one cable penetration into the reactor pressure vessel.

28377 **Aging of electronics with application to nuclear power plant instrumentation.** Johnson, R.T.; Craft, C.M.; Thome, F.V. (Sandia National Laboratories Albuquerque, New Mexico 87185). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Nuclear Science;* **31**: No. 1, 721-725(Feb 1984). (CONF-831015—).

From Nuclear science symposium; San Francisco, CA, USA (19 Oct 1983).

A survey to identify areas of needed research to understand aging mechanisms for electronics in nuclear power plant instrumentation has been completed. The emphasis was on electronic components such as semiconductors, capacitors, and resistors used in safety-related instrumentation in the reactor containment area. The environmental and operational stress factors which may produce degradation during long-term operation were identified. Some attention was also given to humidity effects as related to seals and encapsulants, and failures in printed circuit boards and bonds and solder joints. Results suggest that neutron as well as gamma irradiations should be considered in simulating the aging environment for electronic components. Radiation dose-rate effects in semiconductor devices and organic capacitors need to be further investigated, as well as radiation-voltage bias synergistic effects in semiconductor devices and leakage and permeation of moisture through seals in electronic packages.

28378 **Analysis of random neutron sensor fluctuations for surveillance of nuclear instrumentation channels in nuclear power plant protection systems.** Miller, D.W.; Arndt, S.A.; Behbahani, A.; Talnagi, J.W. (The Ohio State University Nuclear Engineering Program 206 West Eighteenth Avenue Columbus, Ohio 43210). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Nuclear Science;* **31**: No. 1, 711-716(Feb 1984). (CONF-831015—).

From Nuclear science symposium; San Francisco, CA, USA (19 Oct 1983).

The analysis of the random fluctuations from nuetron sensors operating in the current mode has been shown to be a feasible method for monitoring the dynamic state of neutron measurement channels. A laboratory evaluation of both boron-lined and uranium-lined neutron sensors with simulated sensor and signal cable degradation was completed. The experimental evaluation, supported by a theoretical analysis, has demonstrated the potential for using the power spectral density of the random fluctuations on the detection process as an indicator of change in transient response of a neutron measurement channel.

28379 **The high voltage perturbation technique for testing the response of neutron sensors of the type used in nuclear reactors.** Talnagi, J.W.; Arndt, S.A.; Behbahani, A.; Miller, D.W. (The Ohio State University Nuclear Engineering Program 206 West Eighteenth Avenue Columbus, Ohio 43210). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Nuclear Science;* **31**: No. 1, 717-720(Feb 1984). (CONF-831015—).

From Nuclear science symposium; San Francisco, CA, USA (19 Oct 1983).

Perturbation of the high voltage bias supply of neutron sensors of the type used in nuclear reactor protection systems has been demonstrated in a laboratory environment to be a potential method for response time measurement. The laboratory evaluation used simulated sensor and signal cable degradation with boron lined and uranium lined chambers operating in current mode. The investigations have demonstrated the sensitivity of the technique for detecting simulated degradations of the time response of the simulated detector-cable system.

28380 **Digital control of power transients in a nuclear reactor.** Bernard, J.A.; Lanning, D.D.; Ray, A. (Nuclear Reactor Laboratory Massachusetts Institute of Technology 138 Albany Street Cambridge, Massachusetts 02139). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Nuclear Science;* **31**: No. 1, 701-705(Feb 1984). (CONF-831015—).

From Nuclear science symposium; San Francisco, CA, USA (19 Oct 1983).

An integrated, closed-loop, control system for on-line operations in nuclear power plants has been developed and demonstrated with an LSI-11/23 micro-processor on the 5 MWt fission reactor (MITR-II) that is operated by the Massachusetts Institute of Technology. This control system has inherent capabilities to perform on-line fault diagnosis, information display, sensor calibration, and measurement estimation. Recently, its scope has been extended to include the direct digital control of power changes ranging from 20-80% of the reactor's licensed limit. This controller differs from most of those discussed in theoretical and simulation studies by recognizing the non-linearity of reactor dynamics, calculating reactivity on-line, and controlling the rate of change of power by restricting both period and reactivity. The controller functions accurately using rods of non-linear worth in the presence of nonlinear feedback effects.

2205 Environmental Aspects

REFER ALSO TO CITATION(S) 28276, 28458, 29249

28381 **(EPRI-NP—3438) Historical method of seismic hazard analysis. Interim report, May 1984.** Veneziano, D.; Cornell, C.A.; O'Hara, T. (Yankee Atomic Electric Co., Framingham, MA (USA)). May 1984. 119p. Electric Power Research Inst., Box 50490, Palo Alto, CA 94303. Order Number DE84920326.

This report documents a new method for estimating seismic hazard at one or several sites. The method relies on the availability of a historical catalog and can be used as an alternative or a complement to traditional analyses based on seismic sources. Two historical hazard-estimation procedures are described, which differ in their assumptions, in the degree of complexity and in the format of the results. The first (nonparametric) method provides an estimate of the probability of exceeding any given site intensity without a quantified estimation of uncertainty. The second (parametric) method characterizes the same probability as a random variable. Not all the input information required by the historic method is precisely known. For this reason, a computer program has been written, which accepts alternative combinations of earthquake catalog, intensity attenuation, and attenuation error distribution, each with an associated subjective probability of being correct. Because the number of possible combinations of input parameters may be large, a grouping method has been developed to reduce the number of possible hazard functions without misrepresenting the diversity of the results. The program has the additional capability of producing seismic risk maps over extended geographical regions. 12 references, 25 figures, 3 tables.

28382 **(NUREG—0974-FINAL) Final environmental statement related to the operation of Limerick Generating Station, Units 1 and 2 (Docket Nos. 50-352 and 50-353).** (Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Reactor Regulation). Apr 1984. 727p. NTIS, PC A99 - GPO* $12.00. Order Number DE84901058.

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This document contains the second assessment of the environmental impact associated with the operation of the Limerick Generating Station, Units 1 and 2, pursuant to the National Environment Policy Act of 1969 (NEPA) and Title 10 of the Code of Federal Regulations, Part 51, as amended, of the Nuclear Regulatory Commission regulations. This statement examines the environment, environmental consequences and mitigating actions, and environmental and economic benefits and costs. Land use and terrestrial and aquatic ecological impacts will be small. Operational impacts to historic and archeological sites will be negligible. The effects of routine operations, energy transmission, and periodic maintenance of rights of way and transmission facilities should not jeopardize any populations of endangered or threatened species. No significant impacts are anticipated from normal operational releases of radioactivity. The risk of radiation exposure associated with accidental release of radioactivity is very low. The net socioeconomic effects of the project will be beneficial. The action called for is the issuance of operating licenses for Limerick Generating Station, Units 1 and 2.

28383 **(TVA—4901086) Environmental radioactivity levels, Watts Bar Nuclear Plant. Annual report, 1983.** (Tennessee Valley Authority, Muscle Shoals, AL (USA). Radiological Health Staff). Apr 1984. 65p. NTIS, PC A04. Order Number DE84901086.

Paper copy only, copy does not permit microfiche production.

A preoperational environmental radiological monitoring program was implemented in December 1976. This program had the objective of establishing a baseline of data on the distribution of natural and manmade radioactivity in the environment near the plant site. This report presents the results obtained from that program during 1983.

28384 **(TVA/PUB—84/39) Browns Ferry Nuclear Plant low-level radwaste storage facility ground-water pathway analysis.** Boggs, J.M. (Tennessee Valley Authority, Norris (USA). Div. of Air and Water Resources). Oct 1982. 49p. NTIS, PC A03/MF A01. Order Number DE84901240.

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The proposed low-level radwaste storage facility (LLRWSF) at Browns Ferry Nuclear Plant is underlain by soils having low hydraulic conductivity and high sorptive capacity which greatly reduce the risks associated with a potential contaminant excursion. A conservative ground-water pathway accident analysis using flow and solute transport modeling techniques indicates that without interdiction the concentrations of the five radionuclides of concern (Sr-90, Cs-137, Cs-134, Co-60, and Mn-54) would be well below 10 CFR Part 20 criteria at downgradient receptors. These receptors include a possible future private water well located near the eastern site boundary and Wheeler Reservoir. Routine ground-water monitoring is not recommended at the LLRWSF except in the unlikely event of an accident.

28385 **(TVA/PUB—84/40) Sequoyah Nuclear Plant low-level radwaste storage facility ground-water pathway analysis.** Boggs, J.M. (Tennessee Valley Authority, Norris (USA). Div. of Air and Water Resources). Oct 1982. 25p. NTIS, PC A02/MF A01. Order Number DE84901246.

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The proposed low-level radwaste storage facility (LLRWSF) at Sequoyah Nuclear Plant is underlain by soils having low hydraulic conductivity and high sorptive capacity which greatly reduce the risks associated with a potential contaminant excursion. A conservative ground-water pathway accident analysis using flow and solute transport modeling techniques indicates that without interdiction radiological contaminant concentrations in ground water discharging into Chickamauga Lake would be well below 10 CFR Part 20 criteria. There are no potential impacts to groundwater users since there are no private wells in the site vicinity and no potential for future ground-water development. Routine groundwater monitoring is not recommended at the LLRWSF except in the unlikely event of an accident. Although the analysis indicates that the existing monitor well network designed for the originally planned long-term LLRWSF is not the most effective monitor system for the current emergency storage facility, no additional monitor wells are recommended at this time. The extremely slow rate of contaminant movement would allow sufficient time to install additional wells if necessary should an accident occur. Accident mitigation is unwarranted from a technical viewpoint. However, if mitigation is necessary for other reasons, removal of contaminated soils is judged the most cost-effective method.

2206 Research, Test, And Experimental Reactors

REFER ALSO TO CITATION(S) 27989, 28344, 28354, 28429

28386 **(CEA-CONF—6971) Saclay ISIS reactor and its applications.** Alberman, A.; Barbalat, R.; Morin, C. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France)). Oct 1983. 7p. (CONF-831012—12). NTIS (US Sales Only), PC A02/MF A01. Order Number DE84750666.

From International symposium on use and development of low and medium flux research reactors; Cambridge, MA, USA (17 Oct 1983).

The ISIS facility forms part of OSIRIS assembly which is operated by the Commissariat a l'Energie Atomique at C.E.N. Saclay, since 1966. The main characteristics of the ISIS reactor are given. ISIS has been extensively used both as mock-up and as a neutron source; the main points about the applications of ISIS are summarized.

28387 **(CEA-CONF—7019) Training and teaching with SILOETTE reactor and associated simulators at the Nuclear Research Centre of Grenoble.** Destot, M. (CEA Centre d'Etudes Nucleaires de Grenoble, 38 (France)). Oct 1983. 10p. (CONF-831012—11). NTIS (US Sales Only), PC A02/MF A01. Order Number DE84750665.

From International symposium on use and development of low and medium flux research reactors; Cambridge, MA, USA (17 Oct 1983).

Thanks to its three reactors SILOE (35 MW), MELUSINE (8 MW) and SILOETTE (100 KW), the Reactor Department of the Nuclear Research Centre of Grenoble has gained a considerable experience in the operation and utilization of research and material testing reactors. Inside of this general framework, the Reactor Department of Grenoble has built up a training and teaching centre that has been permanently active since 1975, with the aim of satisfying the considerable needs arising from the development of electro-nuclear power stations. The course is mainly intended for engineers and technicians who will be responsible for running power stations. A thorough series of practical exercices, carried out in the SILOETTE training reactor and in a PWR or in a Gas Cooled Reactor Simulator, desmonstrates the application of the theorical courses and familiarises the trainees with the behaviour of reactors and power stations.

28388 (HEDL-SA—3092-S) Material open test assembly processing at the FFTF's IEM cell. Danko, A.D. (Hanford Engineering Development Lab., Richland, WA (USA)). Jan 1984. Contract AC06-76FF02170. 5p. (CONF-840614—46). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE84010317.

From Annual meeting of the American Nuclear Society; New Orleans, LA, USA (3 Jun 1984).

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The Interim Examination and Maintenance (IEM) Cell is a vertical hot cell located within the containment dome of the Fast Flux Test Facility (FFTF). The cell has two basic functions: (1) to perform disassembly/reassembly and nondestructive testing on radioactive, sodium-wetted reactor components, and (2) to provide a shielded work volume where radioactive, sodium-wetted reactor and refueling equipment can be repaired and maintained. One of the recent FFTF experiments processed through the IEM Cell was the Material Open Test Assembly (MOTA). This paper describes the disassembly and reassembly of the MOTA test assembly.

28389 (ORNL/TM—9173) High flux isotope reactor. Quarterly report, July-September 1983. Dahl, T.L.; Farrar, M.B. (Oak Ridge National Lab., TN (USA)). May 1984. Contract AC05-84OR21400. 19p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE84012038.

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Routine reactor operation with four end-of-cycle shutdowns and one unscheduled shutdown resulted in an on-stream time of 81.1% for the quarter. The outer control plates were replaced and a semiannual core component inspection was made. The long beryllium replacement shutdown was begun at the end of Cycle 244 on September 20, 1983.

28390 Twenty years of health physics research reactor operation. Sims, C.S.; Gilley, L.W. (Oak Ridge National Lab., TN). *Nuclear Safety;* **24**: No. 5, 678-688(Sep-Oct 1983).

The Health Physics Research Reactor at the Oak Ridge National Laboratory has been in regular use for more than two decades. Safe operation of this fast reactor over this extended period indicates that (1) fundamental design, (2) operational procedures, (3) operator training and performance, (4) maintenance activites, and (5) management have all been eminently satisfactory. The reactor and its uses are described, the operational history and significant events are reviewed, and operational improvements and maintenance are discussed.

2208 Propulsion Reactors

REFER ALSO TO CITATION(S) 28328

28391 (GKSS—83/E/55) Decommissioning of the nuclear merchant ship OTTO HAHN. Kroeger, J.; Lettnin, H.K.J.; Schmidt, K.; Birkhold, U.; Obst, J. (GKSS-Forschungszentrum Geesthacht G.m.b.H., Geesthacht-Tesperhude (Germany, F.R.)). 1983. 58p. (In German). NTIS (US Sales Only), PC A04/MF A01. Order Number DE84751346.

With NS OTTO HAHN for the first time in the world a nuclear merchant ship and for the first time in FRG a nuclear power plant was decommissioned. Starting from the existing technical and radiological state of the plant the decommissioning concept is shown. Licensing and release procedures including the applied measuring techniques are described and the single phases of the decommissioning work are dealt with. The total masses and activities are balanced and the results of the decommissioning are discussed. With the suspension of the control area and the release of the ship the decommissioning work was finished in June 1982.

2209 Reactor Safety

REFER ALSO TO CITATION(S) 28312, 28318, 28335, 28363

28392 (BMI—1983-008) Probabilistic safety and design goals. Brenig; Hauptmanns; Hoertner; Kollath; Liemersdorf, H.; Otto, W.; Schaefer, H.; Suessenberger, J. (Bundesministerium des Innern, Bonn (Germany, F.R.); Gesellschaft fuer Reaktorsicherheit m.b.H. (GRS), Koeln (Germany, F.R.)). Sep 1983. vp. (In German). (GRS-A—786). Fachinformationszentrum Energie, Physik, Mathematik G.m.b.H., Eggenstein-Leopoldshafen (Germany, F.R.).

The safety goals recently defined and presented in the USA, in Great Britain, Japan, Canada, Argentina and South Africa are explained and classified according to various criteria. An evaluation of methods for verifying the safety goals is done by comparison with the German Reactor Safety Study (DRS). The intrerrelationship between the safety goals presented and the deterministic safety regulations valid in Western Germany are discussed, as well as the technological and experimental efforts undertaken to meet the requirements, as e.g. the core melt-down experiments carried out in this country.

28393 (BMI—1983-014) Evaluation of the reports on the status of quality assurance systems in the power plants. Pt. 1, annex, pt. 2. (Bundesministerium des Innern, Bonn (Germany, F.R.); Gesellschaft fuer Reaktorsicherheit m.b.H. (GRS), Koeln (Germany, F.R.); Rheinisch-Westfaelischer Technischer Ueberwachungs-Verein e.V., Essen (Germany, F.R.); Technischer Ueberwachungs-Verein Rheinland e.V., Koeln (Germany, F.R.)). Sep 1983. 456p. (In German). (GRS-A—686). NTIS (US Sales Only), PC A20/MF A01. Order Number DE84751342.

The problem required the development of a presentation and evaluation of the overall results based on the results of the systems analysis with regard to: - further development of control equipment, - discovery of overlapping points, gaps and weak points, especially at the boundaries between the systems, - standardized application of the principles of efficient quality assurance systems for all participants. The results of the systems analyses for the status of quality assurance in producers and suppliers of systems can be summarized as follows: 1. Both systems analyses show that the quality assurance systems introduced are operable but that there are also some weak points. 2. Basically, the results of the systems analyses coincide; there are differences in the assessment of single issues or in a more detailed treatment. The weak points identified by the systems analysis can be summarized under the following catchwords: - structural organization; here, a greater formalization of the descriptions of positions and qualifications of personnel as well as the presentation of the structural organization in organization charts are required. - Procedural organization resp. operational modulei; here, improvements of the interfaces between the QA systems, information feedback, information and documentation are dealt with and

the revision and improvement of invalid documents (withdrawal/exchange) as well as the qualification mode for auditors are pointed out separately.

28394 **(BMI—1983-016) Investigation of the thermodynamic conditions in an underground nuclear power plant after core melt, in combination with a risk-oriented evaluation.** Hassmann, K.; Eyink, J.; Fischer, M.; Schwarzott, W.; Fabian, H.; Reineke, H.H. (Bundesministerium des Innern, Bonn (Germany, F.R.); Kraftwerk Union A.G., Erlangen (Germany, F.R.)). Nov 1983. 140p. (In German). NTIS (US Sales Only), PC A07/MF A01. Order Number DE84751329.

With 43 refs., 4 tabs., 47 figs.

Based on the present state-of-the-art on the project "Core Melt", funded by the Federal Ministry of Research and Technology (BMFT), the thermodynamic conditions occurring in the safety containment (and/or) outer annulus of undergroud NPPs have been evaluated for selected release categories. In order to evaluate the pressure- and temperature history as well as the leakages, a coupled two-room-model was constructed. The most serious consequences following an accident in an underground nuclear power plant must be expected for the failure of containment isolation valve, as corresponding to release category 2 of the German Risk Study (DRS) which differs only slightly from the accident scenario gained by above-ground siting of nuclear power plants.

28395 **(CEA-CONF—6984) Turbulent natural convection in an enclosure.** Goldstein, S.; Magnaud, J.P. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France)). Aug 1983. 14p. (CONF-830805—88). NTIS (US Sales Only), PC A02/MF A01. Order Number DE84750669.

From 7. international conference on structural mechanics in reactor technology; Chicago, IL, USA (22 Aug 1983).

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This study was motivated by reactor safety consideration. The work has been performed in the frame of more general study, on the behavior of aerosols in a reactor containment, in case of sodium fire on the floor. The filter design depends upon the knowledge of the aerosol concentration in the containment as a function of space and time. The objective of the study is to determine the influence of convection on aerosol transport and deposition. As a first step, we present in this paper the numerical simulation of the turbulent flow induced by a fire and comment the results. The steady state flow is considered in a vertical circular cylinder, with the fire simulated by a constant temperature heat source, located at the center of the floor. The finite-element Tethys-code has been used to predict the turbulent flow using primitive variables in cylindrical coordinates with both, a one-equation turbulent model (K-1) and a two-equations model (K-epsilon). The numerical schemes used are based on the schemes developped by Taylor and Hood and Bercovier. The governing equations are presented; we present a new technique for the wall function calculation in free convection, followed by a description of the numerical method used. The results are presented and discussed.

28396 **(CONF-830545—2) Extended overpower transient testing of oxide pins in EBR-II.** Tsai, H.; Neimark, L.A. (Argonne National Lab., IL (USA)). 10 May 1983. Contract W-31-109-ENG-38. 5p. NTIS, PC A02/MF A01; GPO Dep. Order Number DE84011743.

From Core systems working group information meeting; Richland, WA, USA (10 May 1983).

Understanding of the behavior of oxide fuel and blanket pins during slow transients with ramps between 0.1 and 10%/s is of importance because of the higher likelihood of such operational transient events. Compared to faster transients for which a fair amount of knowledge exists through testing in TREAT, there is also some concern of whether the oxide pins are particularly vulnerable to slower transients. For these reasons, a cooperative program between the US Department of Energy (DOE) and the Japanese Power Reactor and Nuclear Fuel Development Corporation (PNC) was launched to conduct operational transient testing (OTT) on oxide pins in EBR-II. A total of eleven tests is included in this OTT program. The status of the five extended-overpower-transient tests on preirradiated EBR-II pins is the subject of this paper.

28397 **(CONF-840614—4) FRAS3 analysis of transient fission-gas behavior in PNL-10 fuel.** Gruber, E.E. (Argonne National Lab., IL (USA)). 1984. Contract W-31-109-ENG-38. 5p. NTIS, PC A02/MF A01; GPO Dep. Order Number DE84005430.

From Annual meeting of the American Nuclear Society; New Orleans, LA, USA (3 Jun 1984).

The purpose of this work is to demonstrate the capability of the updated FRAS3 code to accurately predict the detailed transient behavior of fission gas in irradiated oxide fuel. The FRAS3 code has been modified in several ways since an earlier evaluation was performed. The most significant modification, in terms of the calculated results, is in the inclusion of the vacancy-depletion effect in the analysis of the growth rate of overpressured intragranular fission-gas bubbles. The code has been applied to analysis of a series of FGR capsule-heating tests of irradiated PNL-10 fuel. This same series of tests was treated in the earlier evaluation exercise, providing a direct comparison between the observations, the original calculated results, and the latest results.

28398 **(CONF-840614—5) Correlation for downward melt penetration into a miscible low-density substrate.** Fang, L.J.; Cheung, F.B.; Pedersen, D.R.; Linehan, J.H. (Argonne National Lab., IL (USA)). 1984. Contract W-31-109-ENG-38. 5p. NTIS, PC A02/MF A01; GPO Dep. Order Number DE84005209.

From Annual meeting of the American Nuclear Society; New Orleans, LA, USA (3 Jun 1984).

Downward penetration of a sacrificial bed material or a concrete basemat structure by an overlying layer of core melt resulting from a hypothetical core disruptive accident has been a major issue in post accident heat removal studies. One characteristic feature of this problem is that the solid substrate, when molten, is miscible with and lighter than the core melt so that the rate of penetration is strongly dependent upon the motion of natural convection in the melt layer driven by the density difference between the core melt and the molten substrate. This fundamentally interesting and technologically important problem has been investigated by a number of researchers. Significantly different melting rates, however, were observed in these studies. Questions concerning the occurrence of flow transition and its effect on melt penetration remain to be answered. To promote the understanding of the phenomena and to strengthen the data base of melt penetration, simulation experiments were conducted using various kinds of salt solutions (KI, NaCl, $CaCl_2$, and $MgCl_2$ solutions) as the working fluid and an air-bubble-free ice slab as the solid substrate.

28399 **(CONF-840614—17) RELAP/FRAP-T6 analysis of seized and sheared shaft accidents.** Bollinger, J.S.; Ito, T.; Peeler, G.B. (Argonne National Lab., IL (USA)). 1984. Contract W-31-109-ENG-38. 6p. NTIS, PC A02/MF A01; GPO Dep. Order Number DE84006470.

From Annual meeting of the American Nuclear Society; New Orleans, LA, USA (3 Jun 1984).

Argonne National Laboratory (ANL) performed audit calculations of a Reactor Coolant Pump (RCP) seized/sheared shaft transient for the Westinghouse Seabrook Plant using RELAP5/MOD 1.5 (Cycle 32) and FRAP-T6. The objective was to determine the effect of time of loss of offsite power and other single component failures on the peak clad temperature. The RCP shaft seizure event was modeled in RELAP5 by using the pump model shaft stop option. In modeling the sheared shaft failure, the faulted pump was replaced with a branch component having no flow losses. In general, the RELAP5-predicted system response for the seized shaft transient was very comparable to the results presented in the Seabrook FSAR, although the Reactor Coolant System (RCS) pressure response was somewhat different. The RELAP5 sheared-shaft analysis results were very similar to those for the seized shaft.

28400 **(CONF-840614—21) Mitigation of thermal transients by tube bundle inlet plenum design.** Oras, J.J.; Kasza, K.E. (Argonne National Lab., IL (USA)). Jun 1984. Contract W-31-109-ENG-38. 7p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE84006406.

From Annual meeting of the American Nuclear Society; New Orleans, LA, USA (3 Jun 1984).

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A multiphase program aimed at investigating the importance of thermal buoyancy to LMFBR steam-generator and heat-exchanger thermal hydraulics under low-flow transient conditions is being conducted in the Argonne Mixing Components Test Facility (MCTF) on a 60° sector shell-side flow model of the Westinghouse straight-tube steam generator being developed under the US/DOE large-component development program. A series of shell-side constant-flow thermal-downramp transient tests have been conducted focusing on the phenomenon of thermal-buoyancy-induced-flow channeling. In addition, it was discovered that a shell-inlet flow-distribution plenum can play a significant role in mitigating the severity of a thermal transient entering a steam generator or heat exchanger.

28401 **(CONF-840614—27) Thermal oscillations downstream of an elbow in stratified pipe flow.** Kuzay, T.M.; Kasza, K.E. (Argonne National Lab., IL (USA)). 1984. Contract W-31-109-ENG-38. 7p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE84006550.

From Annual meeting of the American Nuclear Society; New Orleans, LA, USA (3 Jun 1984).

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In previously published papers, the test geometry, test methodology and the scope of the thermal transient induced pipe stratification studies at Argonne National Laboratory (ANL) were explained. In these prior studies, limited fluid temperature data from elbow inlet and exit plane thermocouples indicated the presence of large-amplitude thermal fluctuations for conditions in which the horizontal pipe upstream of the elbow developed stratified flow induced by a pipe entrant thermal transient. Under severe transient conditions, thermal oscillations of amplitude of almost 70 percent of the pipe inlet transient temperature change were observed in the bulk flow. TC data and accompanying flow visualization test results showed that the largest near wall thermal oscillations were located within and immediately downstream of the elbow. The thermal oscillations if they are of large enough amplitude, of the appropriate frequency, and of sufficiently long duration can cause thermal stripping and thermal-fatigue stress cracking in the elbow region. A specially instrumented test section was fabricated to study these thermal fluctuations.

28402 **(CONF-840614—29) CAMEL II 37-pin/7-pin intra-pin fuel injection test.** Wilson, R.J.; Spencer, B.W.; Erickson, E.G.; Dewey, G.; Hodges, R. (Argonne National Lab., IL (USA)). 1984. Contract W-31-109-ENG-38. 6p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE84006326.

From Annual meeting of the American Nuclear Society; New Orleans, LA, USA (3 Jun 1984).

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It is concluded that the 2-D effects of this test allowed the coolant to bypass the injected fuel, prohibiting any significant intermixing of the fuel and sodium to take place. This lack of intermixing resulted in a benign pressurization event and significantly reduced the fuel sweepout over previous CAMEL tests. The resulting fuel blockage is predicted to be in a coolable state when analyzed with PLUGCO, a numerical computer code for analysis of post-transient blockage coolability.

28403 **(CONF-840647—10) Dynamic structural analysis of a head assembly for a large loop-type LMFBR.** Kulak, R.F.; Fiala, C. (Argonne National Lab., IL (USA)). 1984. Contract W-31-109-ENG-38. 25p. NTIS, PC A02/MF A01; GPO Dep. Order Number DE84009148.

From ASME pressure vessel and piping conference; San Antonio, TX, USA (17 Jun 1984).

An investigation is presented on the dynamic structural response of the primary vessel's head closure to slug impact loadings generated from a 1000 MJ source term. The reference reactor considered was designed in a loop configuration. The head structure consisted of a deck and a triple rotatable plug assembly. Two designs were considered for the deck structure: a reference design and an alternate design. The reference deck was designed as a single flat annular plate. For the alternate design, the deck plate was reinforced by adding an extender cylinder with a flange and flanged webs between the deck-plate and cylinder. The investigation showed that the reference design cannot maintain containment integrity when subjected to slug loading generated by a 1000 MJ source term. It was determined that the head deformed excessively.

28404 **(CONF-840701—10) TREAT light water reactor source term experiments program.** Herceg, J.E. (Argonne National Lab., IL (USA)). Jul 1984. Contract W-31-109-ENG-38. 7p. NTIS, PC A02/MF A01; GPO Dep. Order Number DE84009149.

From Topical meeting on fission product behavior and source term research; Snowbird, UT, USA (15 Jul 1984).

Pre-test calculations indicate that, for the STEP-1 (Source Term Experimental Program) test, cladding temperatures in excess of 4200°F can be reached on a heatup transient similar to that of the AD accident sequence in a 20-min test duration. This is well above the Zircaloy melting point of ~ 3350°F and should provide a degree of cladding disruption sufficient to allow a singificant release of products from the fuel into the flowing steam. The same temperature range can be reached in a 60-min-duration run to simulate the TQUW sequence for the STEP-2 test. The complete paper will present initial experimental results from these two tests and perhaps from the two TMLB' simulations run without and with control rod material in STEP-3 and STEP-4, respectively.

28405 **(DOE/ET/34030—7) High Burnup PWR Ramp Test Program. Fifth semi-annual progress report, October 1, 1982-March 31, 1983.** LaVake, J.C.; Gaertner, M. (C-E Power Systems, Windsor, CT (USA); Kraftwerk Union A.G., Erlangen (Germany, F.R.)). Mar 1984. Contract AC02-80ET34030. 82p. (CEND—417). NTIS (US Sales Only), PC A05/MF A01; 1; GPO Dep. Order Number DE84012138.

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The objective of this program, which is sponsored by the United States Department of Energy and conducted by Combustion Engineering and Kraftwerk Union, is to investigate the power ramp behavior of high burnup PWR-type fuel under fast power ramp conditions. This will be accomplished by reporting the test results fronm 68 previously ramped fuel rodlets (Part 1 of the program) and performing eighteen ramp tests on rodlets having approximately 32 to 46 GWd/MtU burnup (Part 2). Included among these tests are rodlets having modified designs to determine if such designs will improve pellet clad interaction (PCI) behavior. The rodlets are first irradiated in a power reactor in Germany and then ramp tested in the High Flux Reactor at Petten, Netherlands. This report covers the progress of the program from October 1982 through March 1983, the fifth semi-annual period of the program. During this period, the Background Report was issued completing Part 1 of the program. In addition, 3 ramp tests were performed, bringing the total ramp tests performed under Part 2 of the program to 16. Two of the ramped rodlets were placed back in the irradiation facility for further exposure prior to a second ramp test.

28406 **(DOE/ID—10119) Nuclear power plant transients: where are we.** Majumdar, D. (ed.). (USDOE Idaho Operations Office, Idaho Falls). May 1984. 132p. NTIS, PC A07/MF A01; GPO Dep. Order Number DE84012143.

This document is in part a postconference review and summary of the American Nuclear Society sponsored Anticipated and Abnormal Plant Transients in Light Water Reactors Conference held in Jackson, Wyoming, September 26-29, 1983, and in part a reflection upon the issues of plant transients and their impact on the viability of nuclear power. This document discusses state-of-the-art knowledge, deficiencies, and future directions in the plant transients area as seen through this conference. It describes briefly what was reported in this conference, emphasizes areas where it is felt there is confidence in the nuclear industry, and also discusses where the experts did not have a consensus. Areas covered in the document include major issues in operational transients, transient management, transient events experience base, the status of the analytical tools and their capabilities, probabilistic risk assessment applications in operational transients, and human factors impact on plant transients management.

28407 **(DOE/OR/21400—T15) ORNL projects for the NRC Office of Nuclear Regulatory Research. April 1984 monthly highlights.** Malinauskas, A.P.; Winslow, S.G.; Eissenberg, D.M.; Kress, T.S.; Flanagan, G.F.; Fry, D.N.; Haas, P.M.; Chester, R.O. (Oak Ridge National Lab., TN (USA)). 24 May 1984. Contract AC05-84OR21400. 88p. NTIS, PC A05/MF A01; 1; GPO Dep. Order Number DE84012524.

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Highlights of technical progress during April 1984 are presented for ORNL research projects for the Office of Nuclear Regulatory Research.

28408 **(DPST—80-309) Verification of the MOXY code in WRAP for thermal analysis of fuel assemblies in a boiling water reactor during a loss-of-coolant accident.** Reed, R.L. (Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Lab.). 6 May 1980. Contract AC09-76SR00001. 41p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE84012063.

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Comparisons of results from MOXY calculations and from a GE calculation for a BWR/6-218 plant indicate that MOXY can satisfactorily calculate peak clad temperatures (PCT) for BWR LOCA analyses. However, this series of MOXY calculations also predicted variations in PCT as large as 200°F, depending on the values of input data estimated from plots in the GE report. Several key input data were not specified in the GE report and variations in those data may affect the MOXY results. There is good general agreement between the MOXY results and the GE results. MOXY predicts essentially the same time-dependent behavior for PCT as does the GE methods. For the input data values used in this study, all values of PCT predicted by MOXY are within 7% of the GE value. There is general agreement with the GE results for the time-dependent behavior of the average fuel temperature and the fuel pin pressure. However MOXY predicts much higher initial average fuel temperatures and fuel plenum gas pressures than reported in the GE work.

28409 **(EGG-PBS—6554-Rev.1) Improved time integration method for the TRAC-BD1 analytic nodal reactor kinetics equations.** Nigg, D.W.; Putnam, G.E. (EG and G Idaho, Inc., Idaho Falls (USA)). May 1984. Contract AC07-76ID01570. 50p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE84012169.

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This report documents an improved time integration method developed for use with the TRAC-BD1 space-dependent reactor kinetics package. For reactivities below prompt critical the method provides comparable or slightly better accuracy compared to the traditional theta method. For reactivities above prompt critical it is more accurate than the theta method as the time step size is increased. This results in a decrease in execution time for such cases since larger time steps can be used without loss of accuracy.

28410 **(EPRI-NP—3434) Value-impact analysis of selected safety modifications to nuclear power plants. Final report.** Fullwood, R. (Science Applications, Inc., Palo Alto, CA (USA)). Mar 1984. 254p. EPRI-RRC, Box 50490, Palo Alto, CA 94303. Order Number DE84920335.

This report presents results obtained by a team of BWR engineers in the practical application of value-impact analysis (VIA) methodology to eight projects arising from the TMI accident (NUREG-0626) that are typical of those to be or being addressed by nuclear power plant operators. These projects may be classified as primarily hardware, analysis or procedures. It was found that the VIA process was facilitated and made more complete and uniform by the use of forms in which the attributes of each project alternative are presented in the most natural units. The elements of the form may be viewed as forming an attribute vector which may be operated upon by a conversion matrix to convert the attributes into a common unit (e.g. dollars). Alternatively, the vectors may be compared element by element in descending element prioritization. The participants in this project view VIA as a useful figure of merit for comparing projects and not as having rigorous power for decision making. Some projects and some attributes are not suitable for VIA. This report is intended to aid other engineers in applying VIA to alternative plant modifications by providing examples for constructing the analysis, for selecting the attributes, for developing VIA procedural forms, for preparing conversion factors and for comparing project alternatives.

28411 **(EPRI-NP—3448-Vol.1) Procedure for reviewing and improving power plant alarm systems. Volume 1.** Fink, R.T. (MPR Associates, Inc., Washington, DC (USA)). Apr 1984. 243p. EPRI-RRC, Box 50490, Palo Alto, CA 94303. Order Number DE84920352.

This report describes a procedure for review and improvement of power plant alarm systems. The procedure has been applied to review and define improvements for the alarm systems in two nuclear power plants. Although the specific examples of the review process contained in the report are four nuclear power plants, the procedure in general is applicable to fossil plants as well. The procedure is intended for use by utilities and applies to the hardwired annunciator systems that are present in most power plant control rooms. The report includes a set of guidelines for alarm systems which are used in the review process and in the formulation of improvements. The review includes a systematic definition of what conditions should be alarmed in the control room, an evaluation of the visual and audible aspects of alarm presentation, and a review of the systems and procedures used by the operators in interacting with the alarm system. Possible improvements to annunciator systems are described, and specific examples are given to illustrate them. Also, tests that have been performed using a dynamic alarm simulator, for the purpose of evaluating the improvements, are described in this report.

28412 **(EPRI-NP—3448-Vol.2) Procedure for reviewing and improving power plant alarm systems. Volume 2.** Fink, R.T. (MPR Associates, Inc., Washington, DC (USA)). Apr 1984. 127p. EPRI-RRC, Box 50490, Palo Alto, CA 94303. Order Number DE84920353.

This report describes a procedure for review and improvement of power plant alarm systems. This volume comprises three appendices: sample specifications for design of improvements, simulator tests of alarm system attributes, and sample abbreviation lists.

28413 **(EPRI-NP—3459-Vol.1) Experimental study of the diversion cross-flow caused by subchannel blockages. Volume 1. Single-phase flow.** Tapucu, A.; Gencay, S.; Troche, N. (Ecole Polytechnique, Montreal, Quebec (Canada)). Apr 1984. 193p. EPRI-RRC, Box 50490, Palo Alto, CA 94303. Order Number DE84920368.

The hydrodynamic behavior of two laterally interconnected channels with blockages in one of them has been studied experimentally and has been analyzed by means of the COBRA-IIIC Subchannel Code. It is observed that COBRA-IIIC describes the data adequately when the blockage area is less than 60% for smooth blockages and 30% for plate blockages.

28414 **(EPRI-NP—3481) In-plant postaccident radiation transport. Final report, May 1984.** Lahti, G.P.; Johnson, W.J.; Andrews, B.J. (Sargent and Lundy, Chicago, IL (USA)). May 1984. 172p. Electric Power Research Inst., Box 50490, Palo Alto, CA 94303. Order Number DE84920349.

The report develops and illustrates a methodology for combining information on plant system design, operating characteristics and layout with possible system malfunctions, equipment failures, and operator actions to determine the pathways for movement of fission products out of the primary coolant system following an accident involving fuel failure and to demonstrate the impact of the pathways on the in-plant radiation environment. The methodology has been implemented on a microprocessor-based computer, which is used to illustrate the application of the methodology to the evaluation of accident consequences and the advisability of changes in design and operating procedures.

28415 **(EPRI-NP—3492) Steam-water jet analysis. Final report.** Kashiwa, B.A.; Harlow, F.H.; Demuth, R.B.; Ruppel, H.M. (Los Alamos National Lab., NM (USA)). May 1984. Contract W-7405-ENG-36. 117p. NTIS, PC A06/MF A01; 1 - EPRI; GPO Dep. Order Number DE84012077.

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This report presents the results of a theoretical study on the effects of the steam-water jet emitted from a hypothetical rupture in the high-pressure piping pf a nuclear power plant. A set of calculations is presented, incorporating increasingly complex formulations for mass and momentum exchange between the liquid and vapor flow fields. Comparisons between theory and detailed experimental data are given. The study begins with a thorough evaluation of the specification of equilibrium mass and momentum exchange (homogeneous equilibrium) throughout the flow region, a model that generally overpredicts the rate of jet momentum divergence. The study finds that a near-equilibrium momentum exchange rate and a strongly nonequilibrium momentum exchange rate are needed in the region of large vapor-volume fraction to explain the impingement data for fully developed two-phase jets. This leads to the viewpoint that the large-scale jet is characterized by a flow of large liquid entities that travel relatively unaffected by the strongly diverging vapor flow field. The study also finds circumstances in which a persistent core of metastable superheated water can cause much larger impingement pressures than would otherwise be possible. Existing engineering methods are evaluated for jet-loading predictions in plant design. The existing methods appear to be conservative in most possible rupture circumstances with one exception: when the impingement target is about one pipe-diameter away, large enough to capture the full jet, and the rupture flow area is equal to the full pipe flow area, the existing method can produce loadings that are slightly lower than observed for subcooled, flashing discharge. Recommendations have been made to improve the prediction of existing methods under these conditions.

28416 **(GEND-INF—012) Design and operation of the core topography data acquisition system for TMI-2.** Beller, L.S.; Brown, H.L. (EG and G Idaho, Inc., Idaho Falls (USA)). May 1984. Contract AC07-76ID01570. 103p. NTIS, PC A06/MF A01; 1; GPO Dep. Order Number DE84012366.

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Development of effective procedures for recovery from the 1979 accident at the Three Mile Island 2 nuclear station requires a detailed and quantitative description of the postaccident configuration of the core. This report describes the techniques, equipment, and procedures used for making precise ultrasonic, sonar-like measurements of the cavity left in the upper core region as a result of the accident and details the primary results of the measurements. The system developed for the measurements uses computer techniques for the command and control of remote mechanical and electronic equipment, and for data acquisition and reduction. The system was designed, fabricated, and tested; procedures developed; and personnel trained in 4-1/2 months. The primary results are detailed topographic maps of the cavity. A variety of visual aids was developed to supplement the maps and aid in interpreting companion videotape surveys. The measurements reveal a cavity of 9.3 m^3, approximately 26% of the total core volume. The cavity occupies most of the full diameter of the core to an average depth of about 1.5 m and approaches 2 m in places.

28417 **(GEND-INF—027) Proposed methods for defueling the TMI-2 reactor core.** Henrie, J.O. (Rockwell International Corp., Richland, WA (USA)). May 1984. Contract AC07-76ID01570. 27p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE84010879.

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This report constitutes the general concensus of a Debris Defueling Working Group which was established by the US Department of Energy, through EG and G Idaho Inc., to obtain recommendations from nuclear industry representatives concerning techniques for removing fuel debris from the TMI-2 reactor vessel. The current configuration of the reactor core materials is characterized based on the best information available to the group. The overall core removal philosophy of the group is documented. The type of equipment recommended for core removal is described. The need for development testing to support the design and operation of the equipment is discussed.

28418 **(GEND-INF—029-Vol.2) TMI-2 pressure transmitter examination and evaluation of CF-1-PT1, CF-2-LT1, and CF-2-LT2. Volume 2.** Yancey, M.E.; Strahm, R.C. (EG and G Idaho, Inc., Idaho Falls (USA)). Apr 1984. Contract AC07-76ID01570. 25p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE84011033.

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Pressure transmitters CF-1-PT1, CF-2-LT1, and CF-2-LT2 were removed from the Three Mile Island Unit 2 (TMI-2) Reactor Building and examined during FY-83. The purpose of the examination was to establish the operational characteristics and determine the failure mode of two of the three transmitters.

28419 **(HEDL-SA—2578-FP) Design spectra development considering short time histories.** Weiner, E.O. (Hanford Engineering Development Lab., Richland, WA (USA)). 22 Aug 1983. Contract AC06-76FF02170. 18p. (CONF-830805—96). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE84010322.

From 7. international conference on structural mechanics in reactor technology; Chicago, IL, USA (22 Aug 1983).

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The need for generation of seismic acceleration histories to prescribed response spectra arises several ways in structural dynamics. For example, one way of obtaining floor spectra is to generate a history from a foundation spectra and then solve for the floor motion from which a floor spectrum can be obtained. Two separate programs, MODQKE and MDOF, were written to provide a capability of obtaining equipment spectra from design spectra. MODQKE generates or modifies acceleration histories to conform with design spectra pertaining to, say, a foundation. MDOF is a simple linear modal superposition program that solves for equipment support histories using the design spectra conforming histories as input. Equipment spectra, then, are obtained from the support histories using MODQKE.

28420 **(INIS-BR—103) Technical subsidies for the operation of IRD/CNEN emergency vehicles in the case of a nuclear accident at the Angra Nuclear Power Plant with associated radioactive releases to the atmosphere.** Leao, J.L.B. (Instituto de Radioprotecao e Dosimetria, Rio de Janeiro (Brazil)). Mar 1982. 91p. (In Portuguese). NTIS (US Sales Only), PC A05/MF A01. Order Number DE84780190.

Technical support is provided for the operation of an emergency vehicle of Instituto de Radioprotecao e Dosimetria/Comissao Nacional de Energia Nuclear, Rio de Janeiro, Brazil, in the event of uncontrolled release of radioactivity from the Angra Nuclear Power Plant (NPP) to the atmosphere. It is based on internationally adopted emergency decision process philosophy, the concept of 'Protective Action Guide' (PAG), the exposure pathways relevant to nuclear accidents, the measuring systems to be used in obtaining the exposure rate in the effluent 'plume', the methods utilized to predict dose to the population, radioiodine suppression measures, the monitoring instrumentation available to the emergency group, some post-accident considerations and finally, the monitoring that may be carried out from an aircraft. Information is given about the NPP operator's responsabilities with respect to the prediction of the consequences of an accident, as well as methods for thyroid and whole body dose estimation based on exposure to the radioiodine and noble gases present in the effluent plume. The example of the Three Mile Island's incident is used to formulate some observations regarding collective dose to the public estimates derived from measurements made from a helicopter. (Author).

28421 **(IWGFPT—16) OECD-NEA-CSNI/IAEA specialists' meeting on water reactor fuel safety and fission product release in off-normal and accident conditions. Summary report.** Pickman, D.O.; Knudsen, P. (International Atomic Energy Agency, Vienna (Austria). International Working Group on Fuel Performance and Technology for Water Reactors). Oct 1983. 409p. NTIS (US Sales Only), PC A18/MF A01. Order Number DE84900983.

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Papers are presented concerning LOCA data; LOCA modelling; severe fuel damage; fission product behavior; and D-COM blind problem.

28422 **(KFK—3400) Nuclear Safety Project.** (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Projekt Nukleare Sicherheit). Dec 1983. 129p. (In German and English.). NTIS (US Sales Only), PC A07/MF A01. Order Number DE84751336.

The semiannual progress report 1983/1 is a description of work within the Nuclear Safety Project performed in the first six month of 1983 in the nuclear safety field by KfK institutes and departments and by external institutions on behalf of KfK. The chosen kind of this report is that of short summaries, containing the topics work performed, results obtained and plans for future work.

28423 **(KFK—3484) Summary report on research and development work carried out in 1982.** (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Lab. fuer Aerosolphysik und Filtertechnik 1). Feb 1983. 32p. (In German). NTIS (US Sales Only), PC A03/MF A01. Order Number DE84751326.

The Laboratory for Aerosol Physics and Filter Technology LAF I deals with studies on activity discharge (radiological source term) in major activity accidents of the SNR, the stress being on formation, behaviour and separation of nuclear aerosols. Studies on the behaviour of sodium fires and on the separation of sodium aerosols (layer-of-sand filter, moisture separator etc.) are carried out and suggestions for the design of containment system supplied. LAF II concentrates on operation-oriented studies in the field of filter technology for the separation of radioactive gases and aerosols. Furthermore generation mechanisms for aerosols in nuclear facilities and procedures for the reduction of their emission rate are examined. This includes the adaptation and the development measuring and test methods to be used in contaminated areas.

28424 **(KFK—3540) Analysis of thermal propagation during a hypothetical core disruptive accident in a LMFBR reactor.** Buchner, H. (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Projekt Schneller Brueter; Karlsruhe Univ. (T.H.) (Germany, F.R.). Fakultaet fuer Maschinenbau). Jul 1983. 204p. (In German). NTIS (US Sales Only), PC A10/MF A01. Order Number DE84751298.

In order to analyze paths to early permanent neutronic shutdown a basic case has been investigated on several different power levels. In addition some parameter variations to the basic case have been performed. Several characteristic groups for the possible accident sequence have been identified and have been assigned to the respective power levels. This results in critical power levels where other phenomena become dominant for the accident sequence and where the accident sequence therefore changes fundamentally. This assignment led to a "power scale" for the possible accident sequences. The analyses showed the dominant role of the postulated power level for accident sequences and time scales. With the used parameters and with the initial conditions from a SAS analysis for a SNR-type reactor in an ULOF accident, early permanent neutronic shut-down has been achieved for power levels below 3 times nominal power and above 15 times nominal.

28425 **(KFK—3552) UO_2/Zircaloy-4 chemical interactions and reaction kinetics from 1000 to 1700°C under isothermal conditions.** Hofmann, P.; Kerwin-Peck, D.K. (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Inst. fuer Material- und Festkoerperforschung; Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Projekt Nukleare Sicherheit). Nov 1983. 109p. NTIS (US Sales Only), PC A06/MF A01. Order Number DE84751350.

Chemical interactions up to the melting point of zircaloy (Zry) are described. Out-of-pile experiments have been performed to investigate the chemical interaction behavior under possible severe fuel damage conditions. The tests were conducted in inert gas (1 to 80 bar) with 10-cm long Zry cladding specimens filled with UO_2 pellets. The extent of the chemical reaction depends decisively on whether or not good contact between UO_2 and Zry has been established. If solid contact exists, Zry reduces in the UO_2 to form oxygen-stabilized α-Zr(O) and U metal. The U reacts with Zry low in oxygen to form a (U,Zr) alloy rich in U. The liquid (U,Zr) alloy lies between two α-Zr(O) layers. The affinity of Zr for O_2, which results in an O_2 gradient across the cladding, is the driving force for the reaction. The UO_2/Zry reaction obeys a parabolic rate law. The degree of chemical interaction is determined by the extent of oxygen diffusion into the classing, and hence by the temperature and time. The growth of the reaction layers can be represented in an Arrhenius diagram. the UO_2/Zry-4 reaction occurs as rapidly as the steam/Zry-4 reaction above about 1100°C. The maximum measured O_2 content of the cladding is about 6 wt.%. Up to about 9 vol.% of the UO_2 can be chemically dissolved by Zry. In an actual fuel rod, complete release of the volatile fission products in this region of the fuel must therefore be assumed.

28426 **(KFK—3591) Simulated fuel melt movement and relocation in two seven-pin-bundle geometries (SIMBATH out-of-pile experiments Vsub(Th) 74; Vsub(Th) 79).** Peppler, W.; Menzenhauer, P.; Will, H. (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Inst. fuer Reaktorentwicklung; Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Projekt Schneller Brueter). Nov 1983. 66p. NTIS (US Sales Only), PC A04/MF A01. Order Number DE84751309.

The SIMBATH program was initiated to investigate the physical phenomena of transient material movement and relocation during transient overpower (TOP) and loss of flow (LOF) driven TOP accidents in LMFBR's. The energy release during the accident is simulated out of pile by the reaction of a thermite mixture. Two 7-pin experiments have been performed using flowing sodium. In both tests the transient material movement has been recorded by X-ray-cinematography at about 1000 frames per second. The tests have been analysed. The dominant physical phenomena governing the material movement have been estimated.

28427 **(KFK—3601) Post-accident heat removal research: A state of the art review.** Mueller, U.; Schulenberg, T. (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Inst. fuer Reaktorbauelemente; Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Projekt Schneller Brueter). Nov 1983. 129p. NTIS (US Sales Only), PC A07/MF A01. Order Number DE84751307.

For a realistic assessment of the consequence of extremely unlikely reactor accidents resulting in core degradation or core meltdown key questions are how to remove the decay heat from the reactor system and how to retain the radioactive core debris within the containment. Usually, this complex of questions is referred to as Post-Accident Heat Removal (PAHR). In this article the research work on PAHR performed by various institutions during the last decade has been reviewed. The main results have been summarized under the chapter headings "Accident Scenarios," - "Core Debris Accommodation Concepts," and "PAHR Topics." Particular emphasis has been placed on the presentation of the following problems: characteristics and coolability of solid core debris in the vector vessel, heat removal from molten pools of core material, and core-melt interaction with structural materials. Some unresolved or insufficiently answered questions relating to special "PAHR Topics" have been mentioned or discussed at the end of the particular Chapter. Problem areas of major uncertainty have been identified and listed at the end of the review article. They include the following subjects: formation of debris beds and bed characteristics, post dryout behaviour of particle beds, long-term availability and proper location of heat sinks, creep rupture of structures under high thermal loads.

28428 **(MIT-EL—83-003) Investigation of the physical and numerical foundations of two-fluid representation of sodium boiling with applications to LMFBR experiments.** No, H.C.; Kazimi, M.S. (Massachusetts Inst. of Tech., Cambridge (USA). Energy Lab.). Mar 1983. Contract AC02-78ET37218. 353p. NTIS, PC A16/MF A01; 1; GPO Dep. Order Number DE84011316.

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This work involves the development of physical models for the constitutive relations of a two-fluid, three-dimensional sodium boiling code, THERMIT-6S. The code is equipped with a fluid

conduction model, a fuel pin model, and a subassembly wall model suitable for stimulating LMFBR transient events. Mathematically rigorous derivations of time-volume averaged conservation equations are used to establish the differential equations of THERMIT-6S. These equations are then discretized in a manner identical to the original THERMIT code. A virtual mass term is incorporated in THERMIT-6S to solve the ill-posed problem. Based on a simplified flow regime, namely cocurrent annular flow, constitutive relations for two-phase flow of sodium are derived. The wall heat transfer coefficient is based on momentum-heat transfer analogy and a logarithmic law for liquid film velocity distribution. A broad literature review is given for two-phase friction factors. It is concluded that entrainment can account for some of the discrepancies in the literature. Mass and energy exchanges are modelled by generalization of the turbulent flux concept. Interfacial drag coefficients are derived for annular flows with entrainment. Code assessment is performed by simulating three experiments for low flow-high power accidents and one experiment for low flow/low power accidents in the LMFBR. While the numerical results for predryout are in good agreement with the data, those for post-dryout reveal the need for improvement of the physical models. The benefits of two-dimensional non-equilibrium representation of sodium boiling are studied.

28429 **(NIS—633) Closing down and dismantling of research - material testing - and teaching reactors.** Petrasch, P.; Seidler, M.; Stasch, W. (Nuklear-Ingenieur Service G.m.b.H., Hanau (Germany, F.R.)). Feb 1983. 395p. (In German). Nuklear-Ingenieur Service G.m.b.H., Hanau (Germany, F.R.).

This study is subdivided in six topics: - determination of mass and radioactivity of the parts to be dismantled, - identification of future tasks of research and development, - estimation of radiation exposure for workers charged with dismantling, - determination of cost for closing-down and dismantling of research reactors. In total, 22 research-, materials testing- and traning reactors are taken into consideration here. Only those component that belong directly to the reactor proper plus the auxiliary - and service plants are dismantled. The reactor buildings will only be dismantled if the are a direct reactor component serving for example as a biological shield. The waste quantity created by closing-down and dismantling of all research reactors comes up to about 25200 Mg out of that 720 Mg are radioactive wastes. Planning and carrying out of closing-down and dismantling of all research reactors need about 4870 man-months the total cost will be about 86,4 Mio DM. There are vast differences between the individual research reactors. On 10 Mg will have to be disposed in the case of the Siemens training-reactor 100 (SUR-100) of which a very small share consists of radioactive waste; in the case of the research reactor Neuherberg (FRN) there are about 3500 Mg, about 94 Mg out of it is radioactive waste. The work needed per reactor varies between 26 man-months (SUR-100) and about 740 man-months (FRN). Costs for dosing-down and dismantling range between 0,4 Mio DM (SUR-100) and about 13 Mio DM (FRN).

28430 **(NUREG—0420-Suppl.5) Safety evaluation report related to the operation of Shoreham Nuclear Power Station, Unit No. 1 (Docket No. 50-322). Suppl. 5.** (Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Reactor Regulation). Apr 1984. 36p. NTIS, PC A03/MF A01 - GPO* $3.75. Order Number DE84901088.

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The staff has reviewed the applicant's submittal for low-power operation of the Shoreham plant. The staff has performed scoping calculations to verify the results presented by the applicant and has considered the effect of loss of all ac power on transients and accidents. On the basis of this review and with the imposition of the special License Conditions and Technical Specifications noted in this SSER for this mode of operation, the staff finds that operation of Shoreham at power levels up to 5% of rated power without the availability of the permanently installed emergency diesel generators presents no significant risk to the public health and safety.

28431 **(NUREG—0876-Suppl.4) Safety Evaluation Report related to the operation of Byron Station, Units 1 and 2 (Docket Nos. STN 50-454 and STN 50-455).** (Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Reactor Regulation). May 1984. 37p. NTIS, PC A03/MF A01 - GPO* $3.75. Order Number DE84901183.

Supplement No. 4 to the Safety Evaluation Report related to Commonwealth Edison Company's application for licenses to operate the Byron Station, Units 1 and 2, located in Rockvale Township, Ogle County, Illinois, has been prepared by the Office of Nuclear Reactor Regulation of the US Nuclear Regulatory Commission. This supplement reports the status of certain items that had not been resolved at the time of publication of the Safety Evaluation Report.

28432 **(NUREG—0927-Rev.1) Evaluation of water hammer occurrence in nuclear power plants: technical findings relevant to unresolved safety issue A-1.** (Nuclear Regulatory Commission, Washington, DC (USA). Div. of Safety Technology). Mar 1984. 82p. NTIS, PC A05/MF A01 - GPO* $4.50. Order Number DE84900973.

This report, which includes responses to public comments, summarizes key technical findings relevant to the Unresolved Safety Issue A-1, Water Hammer. These findings were derived from studies of reported water hammer occurrences and underlying causes and provide key insights into means to minimize or eliminate further water hammer occurrences. This report does not represent a substitute for current rules and regulations.

28433 **(NUREG—0989) Safety evaluation report related to the operation of River Bend Station (Docket No. 50-458).** (Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Reactor Regulation). May 1984. 600p. NTIS, PC A25/MF A01 - GPO* $11.00. Order Number DE84901091.

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The Safety Evaluation Report for the application filed by the Gulf States Utilities Company, as applicant and owner, for a license to operate the River Bend Station (Docket No. 50-458) has been prepared by the Office of Nuclear Reactor Regulation of US Nuclear Regulatory Commission. The facility is located near St. Francisville, Louisiana. Subject to favorable resolution of the items discussed in this report, the NRC staff concludes that the facility can be operated by the applicant without endangering the health and safety of the public.

28434 **(NUREG—1051) Safety Evaluation Report related to the renewal of the operating license for the research reactor at the University of Kansas (Docket No. 50-148).** (Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Reactor Regulation). May 1984. 71p. NTIS, PC A04/MF A01 - GPO* $4.50. Order Number DE84901250.

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This Safety Evaluation Report for the application filed by the University of Kansas (KU) for a renewal of Operating License R-78 to continue to operate the KU 250-kW open-pool training reactor has been prepared by the Office of Nuclear Reactor Regulation of the US Nuclear Regulatory Commission. The facility is owned and operated by the University of Kansas and is located on the KU campus in Lawrence, Douglas County, Kansas. The staff concludes that the reactor facility can continue to be operated by KU without endangering the health and safety of the public. 17 references, 11 figures, 4 tables.

28435 **(NUREG/CR—2000-Vol.3-No.3) Licensee event report (LER) compilation. Volume 3, Number 3.** (Oak Ridge National Lab., TN (USA)). Apr 1984. Contract AC05-84OR21400. 174p. (ORNL/NSIC—200-Vol.3-No.3). NTIS, PC A08/MF A01; 1 - GPO; GPO Dep. Order Number DE84008540.

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This monthly report contains Licensee Event Report (LER) operational information that was processed into the LER data file of the Nuclear Safety Information Center (NSIC) during the one month period identified on the cover of the document. The LERs

from which this information is derived, are submitted to the Nuclear Regulatory Commission (NRC) by nuclear power plant licensees in accordance with federal regulations. The LER summaries in this report are arranged alphabetically by facility name and then chronologically by event date for each facility. Component, system, keyword, and component vendor indexes follow the summaries.

28436 **(NUREG/CR—2000-Vol.3-No.4) Licensee Event Report (LER) compilation for month of April 1984.** (Oak Ridge National Lab., TN (USA)). May 1984. Contract AC05-84OR21400. 184p. (ORNL/NSIC—200-Vol.3-No.4). NTIS, PC A09/MF A01; 1 - GPO; GPO Dep. Order Number DE84012064.

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This monthly report contains Licensee Event Report (LER) operational information that was processed into the LER data file of the Nuclear Safety Information Center (NSIC) during this period. The LER summaries in this report are arranged alphabetically by facility name and then chronologically by event date for each facility. Component, system, keyword, and component vendor indexes follow the summaries.

28437 **(NUREG/CR—2940) Realistic simulation of severe accidents in BWRs - computer modeling requirements.** Greene, S.R. (Oak Ridge National Lab., TN (USA)). Apr 1984. Contract AC05-84OR21400. 233p. (ORNL/TM—8517). NTIS, PC A11/MF A01; 1 - GPO; GPO Dep. Order Number DE84008499.

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This report documents the results of an assessment performed at Oak Ridge National Laboratory to determine the reactor and containment hardware, systems, and phenomena which must be modeled in realistic boiling water reactor severe accident analysis computer codes. The scope of the assessment is limited to BWR-4, 5, and 6 reactors and Mark I, II, and III containment systems. The report presents a concise review of the subject reactor and containment designs, together with a description of the reactor and containment systems which have the capacity to impact the outcome of severe accidents. The results of recent BWR probabilistic risk assessments are briefly discussed, and a detailed visualization of a BWR core melt accident is presented. Recommendations are made regarding the type of phenomena which should be modeled and the level of modeling sophistication required for various stages of the core melt accident. Finally, the current availability of the necessary models is discussed along with the associated model development priorities.

28438 **(NUREG/CR—3300-Vol.1) Review and evaluation of the Zion Probabilistic Safety Study.** Berry, D.L.; Brisbin, N.L.; Carlson, D.D.; Easterling, R.G.; Hickman, J.W.; Kolaczkowski, A.M.; Kolb, G.J.; Kunsman, D.M.; Swain, A.D.; Von Riesemann, W.A. (Sandia National Labs., Albuquerque, NM (USA)). May 1984. Contract AC04-76DP00789. 479p. (SAND—83-1118-Vol.1). NTIS, PC A21/MF A01; 1 - GPO $9.50; GPO Dep. Order Number DE84012384.

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This report describes the review of the internal and external event plant analyses of the Zion Probabilistic Safety Study (ZPSS). The review was conducted by Sandia National Laboratories. The purpose of the review was to search for areas in the ZPSS where omissions and critical judgments were made which could impact the quantitative results. The review identified several of these areas.

28439 **(NUREG/CR—3305) Comparison of BEACON and COMPARE reactor cavity subckmpartment analyses.** Burkett, M.W.; Idar, E.S.; Gido, R.G.; Lime, J.F.; Koestel, A. (Los Alamos National Lab., NM (USA)). Apr 1984. Contract W-7405-ENG-36. 55p. (LA—9776-MS). NTIS, PC A04/MF A01 - GPO $4.00; GPO Dep. Order Number DE84011866.

In this study, a more advanced best-estimate containment code, BEACON-MOD3A, was ued to calculate force and moment loads resulting from a high-energy blowdown for two reactor cavity geometries previously analyzed with the licensing computer code COMPARE-MOD1A. The BEACON force and moment loads were compared with the COMPARE results to determine the safety margins provided by the COMPARE code. The forces and moments calculated by the codes were found to be different, although not in any consistent manner, for the two reactor cavity geometries studied. Therefore, generic summary statements regarding margins cannot be made because of the effects of the detailed physical configuration. However, differences in the BEACON and COMPARE calculated forces and moments can be attributed to differences in the modeling assumptions used in the codes and the analyses.

28440 **(NUREG/CR—3422-Vol.3) Aerosol release and transport program. Quarterly progress report, July-September 1983.** Adams, R.E.; Tobias, M.L. (Oak Ridge National Lab., TN (USA)). Apr 1984. Contract AC05-84OR21400. 49p. (ORNL/TM—8849/V3). NTIS, PC A03/MF A01; 1 - GPO; GPO Dep. Order Number DE84010349.

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Topics discussed include: (1) several capacitor discharge vaporization (CDV) experiments in the Fuel Aerosol Simulant Test Facility; (2) descriptions of mixed-aerosol experiments 611 and 612, which involved iron oxide and uranium oxide in steam; (3) technical support work for the aerosol test program at Marviken, Sweden; (4) core-melt experiment CM-35, in which tellurium and its oxide were used as additives; (5) progress in construction of a 10-kg core-melt induction furnace; (6) finite-difference calculations of energy deposition in CDV specimens; (7) a steam-only experiment in the NSPP; (8) code implementation activities; and (9) NAUA code validation studies.

28441 **(NUREG/CR—3515) Safety-related operator actions: methodology for developing criteria.** Kozinsky, E.J.; Gray, L.H.; Beare, A.N.; Barks, D.B.; Gomer, F.E. (Oak Ridge National Lab., TN (USA); General Physics Corp., Chattanooga, TN (USA)). Mar 1984. Contract AC05-84OR21400. 154p. (ORNL/TM—8942). NTIS, PC A08/MF A01; 1; GPO Dep. Order Number DE84008552.

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This report presents a methodology for developing criteria for design evaluation of safety-related actions by nuclear power plant reactor operators, and identifies a supporting data base. It is the eleventh and final NUREG/CR Report on the Safety-Related Operator Actions Program, conducted by Oak Ridge National Laboratory for the US Nuclear Regulatory Commission. The operator performance data were developed from training simulator experiments involving operator responses to simulated scenarios of plant disturbances; from field data on events with similar scenarios; and from task analytic data. A conceptual model to integrate the data was developed and a computer simulation of the model was run, using the SAINT modeling language. Proposed is a quantitative predictive model of operator performance, the Operator Personnel Performance Simulation (OPPS) Model, driven by task requirements, information presentation, and system dynamics. The model output, a probability distribution of predicted time to correctly complete safety-related operator actions, provides data for objective evaluation of quantitative design criteria.

28442 **(NUREG/CR—3629) Effect of thermal and irradiation aging simulation procedures on polymer properties.** Bustard, L.D.; Minor, E.; Chenion, J.; Carlin, F.; Alba, C.; Gaussens, G.; LeMeur, M. (Sandia National Labs., Albuquerque, NM (USA)). Apr 1984. Contract AC04-76DP00789. 92p. (SAND—83-2651). NTIS, PC A05/MF A01; 1 - GPO; GPO Dep. Order Number DE84011840.

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Prior to initiating a qualification test on safety-related equipment, the testing sequence for thermal and irradiation aging exposures must be chosen. Likewise, the temperature during irradiation must be selected. Typically, U.S. qualification efforts employ ambient temperature irradiation, while French qualification efforts employ 70°C irradiations. For several polymer materials, the influence of the thermal and irradiation aging sequence, as well as the irradiation temperature (ambient versus 70°C), has been investigated in preparation for Loss-of-Coolant Accident simulated tests. Ultimate tensile properties at completion of aging are presented for three XLPO and XLPE, five EPR and EPDM, two CSPE (HY-

PALON), one CPE, one VAMAC, one polydiallylphtalate, and one PPS material. Bend test results at completion of aging are presented for two TEFZEL materials. Permanent set after compression results are presented for three EPR, one VAMAC, one BUNA N, one Silicone, and one Viton material.

28443 **(NUREG/CR—3632) Methods for implementing revisions to emergency operating procedures. Final report.** Myers, L.B.; Bell, A.J. (Battelle Columbus Labs., OH (USA)). May 1984. Contract AC06-76RL01830. 40p. (PNL—4927). NTIS (US Sales Only), PC A03/MF A01 - GPO $3.75; GPO Dep. Order Number DE84012154.

In response to the Three Mile Island (TMI) accident, the US Nuclear Regulatory Commission (NRC) has published the TMI Action Plan. The TMI Action Plan Item I.C.1 called for the upgrading of Emergency Operating Procedures (EOPs) at nuclear power plants. The program developed from this Action Plan item has resulted in utility efforts to: (1) revise EOPs; (2) train personnel in the use of the EOPs; and (3) implement the revised EOPs. The NRC supported the study presented in this report to identify factors which influence the effectiveness of training and implementation of revised EOPs. The NRC's major concern was the possible effects of negative transfer of training. The report includes a summary of existing methods for implementing revisions to procedures based on interviews of plant personnel, a review of the training literature applicable to the effect of previously learned procedures on the learning of and performance with revised procedures (i.e., negative transfer) and recommendations of methods and schedules for implementing revised EOPs. While the study found that the concern over negative transfer of training was not as great as anticipated, several recommendations were made. These include: (1) overtraining of operators to reduce the effect of observed negative transfer; and (2) implementation of the revised EOPs as soon as possible after training to minimize the time operators must rely upon the old EOPs after having been trained on the revised EOPs. The results of the study should be useful both to the utilities and the NRC in the development and review of EOP implementation programs.

28444 **(NUREG/CR—3633-Vol.3) TRAC-BD1/MOD1: an advanced best estimate computer program for boiling water reactor transient analysis. Volume 3. Code structure structure and programming information.** Singer, G.L. (EG and G Idaho, Inc., Idaho Falls (USA)). Apr 1984. Contract AC07-76ID01570. 122p. (EGG—2294-Vol.3). NTIS, PC E07/MF $7.25; 1 - GPO; GPO Dep. Order Number DE84011597.

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Volume 3 of TRAC-BD1/MOD1 is designed for the programmer or model developer with a need to implement or modify the program. The main difference between MOD1 and the previously released version of TRAC-BD1 is the addition of many new physical models. The main programming improvements are the additions of dynamic dimensioning and free field input processing.

28445 **(NUREG/CR—3639) Large break LOCA analyses for two-loop PWRS with upper-plenum injection.** Dobranich, D.; Buxton, L.D. (Sandia National Labs., Albuquerque, NM (USA)). May 1984. Contract AC04-76DP00789. 75p. (SAND—84-0040). NTIS, PC A04/MF A01; 1 - GPO $4.50; GPO Dep. Order Number DE84012523.

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A series of best-estimate thermal-hydraulic calculations was performed using TRAC-PF1 to simulate a hypothetical loss-of-coolant accident in Westinghouse two-loop pressurized water reactors. Those reactors are equipped for low-pressure injection of emergency coolant directly into the upper plenum of the reactor vessel. This type of injection is referred to as upper plenum injection (UPI). The calculations were performed to evaluate the effectiveness of UPI compared to injection into the vessel downcomer, referred to as downcomer injection (DI). The TRAC results indicated that some channeling of upper plenum injected liquid down the core periphery occurred; however, a large percentage of that liquid was vaporized as it drained toward the lower plenum. This vaporization degraded the bottom-flood quench front compared to that seen in TRAC calculations in which downcomer injection was assumed. For the case of upper plenum injection, counter-current flow limiting conditions at the upper core support plate led to formation of a large subcooled liquid pool in the upper plenum.

28446 **(NUREG/CR—3681-Draft) Mitigative techniques and analysis of generic site conditions for ground-water contamination associated with severe accidents.** Shafer, J.M.; Oberlander, P.L.; Skaggs, R.L. (Pacific Northwest Lab., Richland, WA (USA)). Apr 1984. Contract AC06-76RL01830. 368p. (PNL—5072). NTIS, PC A16/MF A01; 1 - GPO $8.00; GPO Dep. Order Number DE84011213.

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The purpose of this study is to evaluate the feasibility of using ground-water contaminant mitigation techniques to control radionuclide migration following a severe commercial nuclear power reactor accident. The two types of severe commercial reactor accidents investigated are: (1) containment basemat penetration of core melt debris which slowly cools and leaches radionuclides to the subsurface environment, and (2) containment basemat penetration of sump water without full penetration of the core mass. Six generic hydrogeologic site classifications are developed from an evaluation of reported data pertaining to the hydrogeologic properties of all existing and proposed commercial reactor sites. One-dimensional radionuclide transport analyses are conducted on each of the individual reactor sites to determine the generic characteristics of a radionuclide discharge to an accessible environment. Groundwater contaminant mitigation techniques that may be suitable, depending on specific site and accident conditions, for severe power plant accidents are identified and evaluated. Feasible mitigative techniques and associated constraints on feasibility are determined for each of the six hydrogeologic site classifications. The first of three case studies is conducted on a site located on the Texas Gulf Coastal Plain. Mitigative strategies are evaluated for their impact on contaminant transport and results show that the techniques evaluated significantly increased ground-water travel times. 31 references, 118 figures, 62 tables.

28447 **(NUREG/CR—3700) Decay of buoyancy driven stratified layers with applications to Pressurized Thermal Shock (PTS).** Theofanous, T.G.; Nourbakhsh, H.P.; Gherson, P.; Iyer, K. (Purdue Univ., Lafayette, IN (USA). School of Nuclear Engineering). May 1984. 212p. NTIS, PC A10/MF A01 - GPO* $6.50. Order Number DE84901251.

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This report consists of two parts. In Part I physically based calculational models are proposed for predicting (a) conditions for stratification due to HPI in a circulating reactor loop (stratification model) and (b) cooldown transients due to HPI in a stagnated primary reactor fluid (thermal mixing model). The integral aspects of these models are confirmed by comparison to the CREARE 1/5-scale data. In Part II the thermal mixing model is assessed in an integral as well as in a local sense by comparison to the first round of data from Purdue's 1/2-scale facility. These data are the only available large-scale data at this time and they are an important complement to CREARE's 1/5-scale results in constructing a basis for scale-up to reactor conditions. Facility construction, instrumentation, data reduction techniques and detailed experimental results are also included in Part II.

28448 **(NUREG/CR—3748) COBRA/TRAC simulation of semiscale S-UT-5 test.** Bian, S.H.; Thurgood, M.J. (Pacific Northwest Lab., Richland, WA (USA)). Apr 1984. Contract AC06-76RL01830. 100p. (PNL—5065). NTIS (US Sales Only), PC A05/MF A01; 1 - GPO $4.75; GPO Dep. Order Number DE84012073.

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The computer code COBRA/TRAC was used to simulate a Small-Break Loss-of-Coolant Accident (SBLOCA) test performed at the Semiscale MOD-2A Test Facility operated by the Idaho National Engineering Laboratory. The results of the simulation were compared with the results of the actual test. The comparison showed that the COBRA/TRAC calculation gave a reasonable match with the measured data and that the code has the capability to model small-break accidents in an integrated coolant system of a pressurized water reactor (PWR).

28449 **(NUREG/CR—3762) Identification of equipment and components predicted as significant contributors to severe core damage.** Heiselmann, H.W. (EG and G Idaho, Inc., Idaho Falls (USA)). May 1984. Contract AC07-76ID01570. 67p. (EGG—2311). NTIS, PC A04/MF A01; 1 - GPO; GPO Dep. Order Number DE84011359.

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The Nuclear Regulatory Commission, Office of Nuclear Regulatory Research, sponsored the Equipment Qualification Research Program which performed a survey of applicable severe accident study reports to aid in focusing the program efforts. Objective was to identify equipment and components that have been predicted to be significant contributors to high probability accident sequence resulting in severe core damage.

28450 **(ORAU/IEA—83-11(M)) CANDU-PHW reactor in relation to a Second Nuclear Era.** Siddall, E. (Oak Ridge Associated Universities, Inc., TN (USA)). May 1984. Contract AC05-76OR00033. 29p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE84012272.

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The reasons for the emergence and successful development of the CANDU-PHWR system are outlined. A plant of typical present-day design is described, with tabulated parameters and dimensions for two sizes. Technical, economic, and commercial differences from other reactor types are considered, including investment patterns and consumption of the basic uranium resource. Safety aspects are compared with those of other reactor types and a condensed risk assessment is given. The separate question of licensability is discussed, with the conclusion that this is unpredictable because of the nature of the licensing process. It is concluded that CANDU-PHWR is a viable system for a Second Nuclear Era.

28451 **(PB—84-160936) Decommissioning nuclear power plants. Memo file.** Denys, C.J. (Illinois Legislative Council, Springfield (USA)). Oct 1983. 49p. NTIS, PC A03/MF A01.

Three approaches to decommissioning are considered: permanent entombment, safe storage, and dismantlement. The cost of decommissioning is addressed, and it is noted that approximately 33 percent of the cost is for shipment and disposal of radioactive materials while only about 19 percent is for demolition of the remaining contaminated structure. Financing options are summarized, including deposit method, unfunded reserve, and general tax revenues. It is concluded that because Illinois has the largest nuclear power capacity of any state and because it has the oldest privately built commercial nuclear power plant in the country, its state government should act to get the federal government to expedite promulgation of the desired standards, regulations, and guidelines for decommissioning.

28452 **(PB—84-161025) Note on parallel processing techniques for algebraic equations, ordinary differential equations and partial differential equations.** Allidina, A.Y.; Malinowski, K.; Singh, M.G. (Manchester Univ. Inst. of Science and Technology (UK). Control Systems Centre). Dec 1982. 46p. NTIS, PC E04/MF E04.

The possibilities were explored for enhancing parallelism in the simulation of systems described by algebraic equations, ordinary differential equations and partial differential equations. These techniques, using multiprocessors, were developed to speed up simulations, e.g. for nuclear accidents. Issues involved in their design included suitable approximations to bring the problem into a numerically manageable form and a numerical procedure to perform the computations necessary to solve the problem accurately. Parallel processing techniques used as simulation procedures, and a design of a simulation scheme and simulation procedure employing parallel computer facilities, were both considered.

28453 **(PB—84-162346) Treatment of physical and numerical diffusion in fluid dynamic simulations. Final report.** Huh, K.Y.; Golay, M.W. (Massachusetts Inst. of Tech., Cambridge (USA). Energy Lab.). Aug 1983. 215p. (MIT/EL—83-011). NTIS, PC A10/MF A01.

A computer code is developed to predict the behavior of the hydrogen gas in the containment after a loss-of-coolant accident. The conservation equations for the four components, i.e., air, hydrogen, steam and water, are set up and solved numerically by decoupling the continuity and momentum equations from the energy, mass diffusion and turbulence equations. The homogeneous mixture form is used from the momentum and energy equations and the steam and liquid droplets are assumed to be in the saturation state. There are two diffusion processes, molecular and turbulent, which should be modelled in different ways. Molecular diffusion is modelled by the Wilke's formula for the multi-component gas diffusion, where the diffusion constants are dependent on the relative concentrations. Turbulent diffusion is basically modelled by the k- model with modifications for low Reynolds number flow effects. Numerical diffusion is eliminated by a corrective scheme which is based on accurate prediction of cross-flow diffusion.

28454 **(PB—84-163658) Use of a heat transfer coefficient for describing the radiactive exchange between water vapour and the bounding walls. Final report.** Eifler, W.; Shepherd, I.M. (Commission of the European Communities, Luxembourg). 1984. 54p. (EUR—8344-EN). NTIS, PC E04/MF E04.

During the 'severe-fuel-damage' experiments of the SUPER SARA test program, radiation heat transfer will play an important part and should be modelled for analyzing these experiments. Based on the same engineering type principles which are used in the radiation model of the TRAC code version for boiling water reactors, a new model has been developed. This model consumes less computer time than the TRAC model and is particularly appropriate for use in the sub-channel-type bundle computer code which will be developed for the analysis of the 'severe-fuel-damage' experiments. Sample calculations for the 'severe-fuel-damage' test array show that in general the difference between the results obtained with the new model and those obtained with the TRAC model is not significant. (Copyright (c) ECSC-EEG-EAEC Brussels Luxembourg 1983.)

28455 **(SAND—84-0097C) Severe accident risk benchmarking and cost-benefit analysis.** Benjamin, A.S.; Haskin, F.E.; Hatch, S.W.; Kunsman, D.M.; Strip, D.R.; Galyean, W.E. (Sandia National Labs., Albuquerque, NM (USA); Science Applications, Inc., La Jolla, CA (USA)). 1984. Contract AC04-76DP00789. 5p. (CONF-840614—9). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE84005526.

From Annual meeting of the American Nuclear Society; New Orleans, LA, USA (3 Jun 1984).

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Sandia National Laboratories is conducting the Severe Accident Risk Reduction Program (SARRP) as part of the NRC Severe Accident Research Plan (SARP). The purpose of this program is to provide NRC with a sound technical basis for severe accident decision making. To achieve this purpose, SARRP has the following objectives: incorporate insights gained from severe accident research toward a benchmarking of reactor risks and of the overall uncertainty in reactor risks; investigate the use of generic plant categories as a means for generalizing the results of plant-specific risk analyses; and evaluate the benefits and costs of proposed new safety features designed to reduce the frequencies and/or consequences of severe accidents.

28456 **(TPR-NS—24-No.5) Nuclear safety, Volume 24, No. 5. Technical progress review, Septembter-October 1983.** Cottrell, W.B. (ed.). (Oak Ridge National Lab., TN (USA)). 1983. 164p. GPO-$6.50. Order Number DE83017001.

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Separate abstracts were prepared for the 7 articles included. (HDR)

28457 **(TPR-NS—25-No.1) Nuclear safety, Volume 25, No. 1. Technical progress review, January-February 1984.** (Oak Ridge National Lab., TN (USA)). Jan 1984. 174p. GPO $6.50. Order Number DE84004747.

A separate abstract was prepared for each of the 6 articles included. (HDR)

28458 Nuclear energy, public health and public policy. Fabrikant, J.I. (Univ. of California, Berkeley). *Health Physics;* **46**: No. 4, 739-744(Apr 1984). Contract AC03-76SF00098.

From 109. annual APHA meeting; Los Angeles, CA, USA (1 Nov 1981).

A guest editorial dealing with the positive aspects of nuclear power is presented. The safety and accident records of the industry is based on engineering technologies of reactors built during the first two decades after the introduction of commercial nuclear power. The author comments that the future record will be based on the development of more attractive features in new reactor designs. Siting studies and radioactive waste disposal are discussed. The editorial concludes with a discussion of science, public policy and the public's acceptability of risk.

28459 In-plant considerations for off-site emergency response to reactor accidents. Burke, R.P.; Heising, C.D.; Aldrich, D.C. (Massachusetts Inst. of Tech., Cambridge). *Health Physics;* **46**: No. 4, 763-773(Apr 1984).

This study develops in-plant decision criteria for immediate off-site emergency-response implementation during severe accidents at nuclear power reactors. Decision criteria are defined based on reactor-accident physical processes, in-plant accident monitoring information, and results of consequence calculations performed to determine the effectiveness of offsite protective measures vs the time of their implementation. A simple plant information management scheme is developed based on generic PWR considerations.

28460 Sandia Laboratories studies 'coolability' of nuclear fuel under Nuclear Regulatory Commission's fuel-damage program. *Energy Research Reports;* **10**: No. 3, 1-2(13 Feb 1984).

Tests are underway at Sandia Laboratories to determine how well damaged fuel at a commerical nuclear power plant could be cooled during a serious accident. As part of the Nuclear Regulatory Commission's Severe Fuel Damage Research Program, the experiments are the first to heat actual light-water reactor (LWR) core debris by nuclear fission in order to simulate internal heating that would occur by radioactive decay in the reactor core. If natural coolability cannot be confirmed, use of coolant pumps or other mechanical devices would be essential. Tests of 0.3 mm particle size debris found the bed difficult to cool, but researchers expect tests of two-three mm particles to show enhanced coolability.

28461 Nuclear safety in Sweden: policy and practice. Pershagen, B.; Nilson, R. (Studsvik Energiteknik AB, Nykoeping, Sweden). *Nuclear Safety;* **25**: No. 1, 1-18(Jan-Feb 1984).

This article reviews principles and practices for reactor safety, radiation protection, and waste management in Sweden. The legislative framework and organizational structure are briefly described. The application of safety concepts to the design and operation of nuclear facilities is examined. Operating experiences and plant modifications for improving safety are summarized. Current safety issues, including probabilistic safety studies, filtered containment venting, and concepts for final waste disposal are reviewed. The lines of safety research are indicated, and some major projects are highlighted. Finally, a novel concept of an intrinsically safe light-water reactor which has been studied in Sweden for some time, is referred to.

28462 Risk-oriented analysis on the German prototype fast breeder reactor SNR-300. Bayer, A.; Koeberlein, K. (Kernforschungszentrum Karlsruhe, Germany; Gesellschaft fuer Reaktorsicherheit, Garching, Germany). *Nuclear Safety;* **25**: No. 1, 19-32(Jan-Feb 1984).

On request of a fact-finding committee of the German Federal Parliament, a risk-oriented analysis on the SNR-300, the German prototype fast breeder reactor, has been performed to allow a pragmatic safety comparison of the SNR-300 and a modern light-water reactor. Results of the technical plant analysis have been summarized in seven release categories. Accident consequences have been calculated for the actual site at Kalkar/Rhine. The results indicate that for the SNR-300 both the frequency of major accidents and the consequences of accidents are smaller than for the pressurized-water reactor analyzed in the German Risk Study. This article summarizes the methods and main results of the analysis of the SNR-300.

28463 Modeling transients in PWR steam generator units. Kalra, S.P. (Electric Power Research Inst., Palo Alto, CA). *Nuclear Safety;* **25**: No. 1, 33-52(Jan-Feb 1984).

The philosophy of, the need for, and the approaches to modeling of transients in steam generator units in pressurized-water-reactor (PWR) systems are identified. Typical design characteristics for both U-tube and once-through steam generators are discussed, and the experimental approach to transient modeling and its application are presented. The present capabilities of both one-dimensional and multidimensional analysis of steam generator performance during PWR plant transients are discussed. A state-of-the-art review of the available analytical tools (codes) for predicting transient behavior of PWR steam generator units is presented as well as a brief review of the current status of the modeling of steam generator transients in PWR nuclear power plants.

28464 Hydrogen behavior in light-water reactors. Berman, M.; Cummings, J.C. (Sandia National Labs., Albuquerque, NM). *Nuclear Safety;* **25**: No. 1, 53-74(Jan-Feb 1984).

The Three Mile Island accident resulted in the generation of an estimated 150 to 600 kg of hydrogen, some of which burned inside the containment building, causing a transient pressure rise of roughly 200 kPa (2 atm). With this accident as the immediate impetus and the improved safety of reactors as the long-term goal, the nuclear industry and the Nuclear Regulatory Commission initiated research programs to study hydrogen behavior and control during accidents at nuclear plants. Several fundamental questions and issues arise when the hydrogen problem for light-water-reactor plants is examined. These relate to four aspects of the problem: hydrogen production; hydrogen transport, release, and mixing; hydrogen combustion; and prevention or mitigation of hydrogen combustion. Although much has been accomplished, some unknowns and uncertainties still remain, for example, the rate of hydrogen production during a degraded-core or molten-core accident, the rate of hydrogen mixing, the effect of geometrical structures and scale on combustion, flame speeds, combustion completeness, and mitigation-scheme effectiveness. This article discusses the nature and extent of the hydrogen problem, the progress that has been made, and the important unresolved questions.

28465 Progress in the recovery operations at Three Mile Island Unit 2. Kalman, G.; Weller, R. (Nuclear Regulatory Commission, Middletown, PA; Nuclear Regulatory Commission, Washington, DC). *Nuclear Safety;* **25**: No. 1, 88-113(Jan-Feb 1984).

This article presents a review and summary of the progress to date in the recovery from the aftermath of the accident at Three Mile Island Unit 2 on March 28, 1979. Principal recovery activites are described, including radioactive waste management, decontamination, maintenance of safe shutdown, and efforts toward defueling. The latest schedule indicates that recovery will not be completed until at least mid-1988. Occupational exposure, the most significant environmental impact from the conduct of the recovery to date, has been less than that incurred at a typical operating pressurized-water reactor. However, the most difficult recovery task, defueling, lies ahead. The present status of recovery and future work to complete recovery are described.

28466 French approach to nuclear power safety. Tanguy, P. (CEA, Fontenay-aux-Roses, France). *Nuclear Safety;* **24**: No. 5, 589-606(Sep-Oct 1983).

This article presents the general concepts used in the safety approach in France and some information on their application to the design and operation of nuclear plants. A brief description of the French safety organization and the fundamental philosophy underlying various safety actions associated with pressurized-water-reactor installations are included.

28467 **Assessment of degraded nuclear piping by experimentation and tearing instability fracture mechanics analysis.** Kanninen, M.F.; Wilkowski, G.; Ahmad, J.; Pan, J.; Marschall, C.W.; Gilbert, R.; Popelar, C. (Southwest Research Inst., San Antonio, TX; Battelle Columbus Labs., OH; Pacific Northwest Labs., Richland, WA; Ohio State Univ., Columbus). *Nuclear Safety;* **24**: No. 5, 617-623(Sep-Oct 1983).

This article describes the initial phase of a Nuclear Regulatory Commission-supported research program to critically assess the use of the tearing instability theory of elastic-plastic fracture mechanics for analyzing cracked piping in nuclear power plants. One accomplishment was the extension of tearing instability analysis procedures to apply to strain-hardening materials. The resulting formulation contains all previously known solutions as special cases. Additional activities included the accumulation of relevant pipe fracture experimental data and the identification of sources of in-service degraded piping for the experiments to be performed in the second phase of the research. These findings will provide the basis for the experimental test matrix planned for the further research to be conducted.

28468 **Influence of test and repair strategies on the unavailability of safety systems.** Kleppmann, W.G. (Technischer Ueberwachungs-Verein, Stuttgart, Germany). *Nuclear Safety;* **24**: No. 5, 628-636(Sep-Oct 1983).

A parameter study of the influence of test and repair strategy on the average unavailability of redundant safety systems is made. It is shown that for a given test interval the optimum strategy is to test the different redundancies staggered in time and to test all components of one redundancy simultaneously. Furthermore it is shown that the relative increase of the average unavailability due to repairs is proportional to the ratio of average repair time to test interval. The constant of proportionality depends only very little on statistical parameters, if after the discovery of a fault in one redundancy at least one other redundancy is tested. A conservative approximation for the repair contribution to the unavailability is derived.

28469 **Analysis of dependent failures in risk assessment and reliability evaluation.** Fleming, K.N.; Mosleh, A.; Kelley, A.P. Jr. (Pickard, Lowe and Garrick, Inc., Irving, CA; Gas-Cooled Reactors Associates, La Jolla, CA). *Nuclear Safety;* **24**: No. 5, 637-657(Sep-Oct 1983).

The ability to estimate the risk of potential reactor accidents is largely determined by the ability to analyze statistically dependent multiple failures. The importance of dependent failures has been indicated in recent probabilistic risk assessment (PRA) studies as well as in reports of reactor operating experiences. This article highlights the importance of several different types of dependent failures from the perspective of the risk and reliability analyst and provides references to the methods and data available for their analysis. In addition to describing the current state of the art, some recent advances, pitfalls, misconceptions, and limitations of some approaches to dependent failure analysis are addressed. A summary is included of the discourse on this subject, which is presented in the Institute of Electrical and Electronics Engineers/American Nuclear Society PRA Procedures Guide.

28470 **Environmental qualification of essential safety-related equipment for nuclear power plants.** McNeill, H. (Terry Corp., Windsor, CT). *Nuclear Safety;* **24**: No. 5, 658-670(Sep-Oct 1983).

Nuclear Regulatory Commission (NRC) regulations require that all safety-related equipment used in a nuclear power plant be functionally serviceable for all environmental conditions that might occur during the licensed interval. In-service aging due to environmental or operational stress can lead to common-mode failure of redundant safety systems. Therefore functionability must be demonstrated by placing the safety-related equipment in its end-of-qualified-life, or aged, condition and then subjecting it to design-basis events. This article presents an overview of qualification technology, updated to the present state of the art, and current NRC requirements.

25 ENERGY STORAGE

REFER ALSO TO CITATION(S) 28258, 28855

28471 **(SERI/TP—252-2107) Benefits from energy storage technologies.** Copeland, R.J.; Kannberg, L.D.; O'Connell, L.G.; Eisenhaure, D.; Hoppie, L.O.; Barlow, T.M.; Steele, R.S.; Strauch, S.; Lawson, L.J.; Sapowith, A.P. (Solar Energy Research Inst., Golden, CO (USA)). Nov 1983. Contract AC02-83CH10093. 8p. (CONF-840201—11). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE84000097.

From ASME energy sources technology conference and exhibition; New Orleans, LA, USA (12 Feb 1984).

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The United States is continuing to rely upon nondomestic and nonsecure sources of energy. Large quantities of energy are lost as a result of time mismatches between the supply and the demand for power. Substantial improvements in energy efficiency are possible through the use of improved energy storage; advanced energy storage can also improve the utilization of domestic energy resources (coal, geothermal, solar, wind, and nuclear) by providing energy in accordance with a user's time-varying needs. Advanced storage technologies offer potentially substantial cost and performance advantages but also have significant technical risk. If even a fraction of the proposed technologies reach fruition, they will make an important contribution to better use of our domestic energy resources. The Energy Storage and Transport Technologies Committee of the American Society of Mechanical Engineers encourages research, development, and application of energy storage technologies to reduce imports and energy costs.

2501 Magnetic

28472 **(ANL—84-19) Magnetically confined kinetic-energy storage ring: a new fundamental energy-storage concept.** Hull, J.R.; Iles, M.K. (Argonne National Lab., IL (USA)). Feb 1984. Contract W-31-109-ENG-38. 109p. NTIS, PC A06/MF A01; GPO Dep. Order Number DE84011531.

The magnetically confined kinetic-energy storage ring (MCKESR) is a new, fundamental type of energy-storage device. Energy is stored as kinetic energy in mass circulated at high velocity around a circular loop. The constraining force necessary to keep the circulating ring from flying apart is provided by radial, inwardly directed forced exerted along the perimeter of the loop by magnetic fields. The magnets and ring are contained in a tunnel, which may be buried in the ground. Levitational support against gravity is also provided by magnetic fields. Energy insertion or extraction is similar to that for a synchronous motor.

28473 **(EPRI-EM—3457) Conceptual design and cost of a superconducting magnetic energy storage plant. Final report.** Loyd, R.J.; Moyer, G.F.; Purcell, J.R.; Alcorn, J. (Bechtel Group, Inc., San Francisco, CA (USA); GA Technologies, Inc., San Diego, CA (USA)). Apr 1984. 626p. EPRI-RRC, Box 50490, Palo Alto, CA 94303. Order Number DE84920338.

This report presents the results of the work performed to develop a conceptual design and cost estimate for a superconducting magnetic energy storage (SMES) plant. The project was divided into two phases. Phase I evaluated the technical features and costs of three 5500 MWh, 500 MW SMES concepts. The concepts evaluated were a low aspect ratio coil, a multiple tunnel moderate aspect ratio coil, and a single tunnel moderate aspect ratio coil. The Phase II analysis presents the overall plant conceptual design as well as design factors for each major SMES plant component necessary for a utility installation. Also presented are the necessary licensing and geotechnical activities, the construction requirements, plant operation and maintenance requirements, and estimates of plant availability and performance characteristics. The report concludes with capital, operating and maintenance cost estimates, key issues requiring further work, and potential plant cost reduction opportunities.

2503 Pumped Hydro

28474 (TVA/PUB—84/26) Pumped-storage hydropower schemes. Ragsdale, B.G. (Tennessee Valley Authority, Knoxville (USA). Office of Engineering Design and Construction). 1984. 34p. NTIS, PC A03/MF A01. Order Number DE84901141.

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The general types of pumped-storage plants and considerations for determining their need, use, and selection are presented. A brief discussion of TVA's experience on two pumped-storage schemes is included. Pumped-storage plants have become an integral part of many hydropower systems. Most of these systems use pumped-storage plants to meet power requirements during the peak load demands. In any application, large or small, the expected load demand and supply source must be identified to select the best scheme required for the particular system.

2505 Flywheels

REFER ALSO TO CITATION(S) 28717

2506 Thermal

REFER ALSO TO CITATION(S) 28190

28475 (AD-A—137635/9) Etude de la recharge de l'accumulateur plomb-acide red camel entre +20 c et -30 c (a study of the rechargeability of the red camel lead-acid battery between +20 c and -30 c). Technical note. Brossard, L.; Verville, G.; Gorman, R.W. (Defence Research Establishment, Ottawa, Ontario (Canada)). Oct 1983. 22p. (DREO-TN—83-36). NTIS, PC A02/MF A01.

No abstract available.

28476 (ORNL/Sub—83-28915/1) Description of six representative thermal energy storage installations. Lorsch, H.G.; Baker, M.A. (Franklin Research Center, Philadelphia, PA (USA)). May 1984. Contract AC05-84OR21400. 87p. NTIS, PC A05/MF A01; 1; GPO Dep. Order Number DE84012020.

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From a survey of thermal energy storage installations in commercial buildings in the U.S. and Canada, six representative systems were selected and are described in detail. Each of the six represents a different type of thermal storage system - ice, chilled water, combined chilled and hot water, pressurized hot water, hot sand/gravel under floor, and brick storage furnace. For each system described, design data, operating performance, and costs are given and compared with conventional heating and cooling systems. The project was undertaken in order to familiarize designers and potential users with thermal energy storage systems for building applications.

28477 (ORNL/TM—8914) Thermal energy storage program annual operating plan FY 1984. Martin, J.F.; Olszewski, M.; Tomlinson, J.J. (Oak Ridge National Lab., TN (USA)). Apr 1984. Contract AC05-84OR21400. 60p. NTIS, PC A04/MF A01. Order Number DE84011828.

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The Thermal Energy Storage (TES) program operating plan for FY 1984 is presented. The overall program goal, program objectives, specific program elements, and program implementation plans are defined. The overall work breakdown structure is shown and specific elements of the program which will be pursued in FY 1984 are defined. The objectives, rationale for inclusion in the program financial budgets, and milestones for each element are given. The ORNL TES program management plan is presented.

2508 Chemical

REFER ALSO TO CITATION(S) 28008, 28190, 28714

2509 Batteries

REFER ALSO TO CITATION(S) 28675, 28676, 28890, 28919

28478 (BMFT-FB-T—83-305) Development of a new charger system. Courbiere, R. von; Klein, F.; Kolen, P.; Oosterhoff, F.; Thomas, R. (Bundesministerium fuer Forschung und Technologie, Bonn (Germany, F.R.)). Dec 1983. 285p. (In German). NTIS (US Sales Only), PC A13. Order Number DE84751235.

Paper copy only, copy does not permit microfiche production; With 13 refs., 7 tabs., 27 figs.

Chopper type charger-baseline units with up to 3,5 kW power have been developed. With the three variations: Step-up converter with mains transformer; Step-up converter with step-down converter; Step-up converter with forward converter the advantages of this technology could be proved. By applying these types of power controls it was nearly possible to create the mains corresponded behaviour of an ideal ohmic load. The power- and energyefficiencies have been increased by up to 60%. Dependent on the type of power control the power/weight ratio was reduced by nearly 50%. For testing the chargers a computerized data aquisition system was used, which at that time was not commercially available. The necessary adaptions which enable the charger-baseline unit to form high power units by combination and the integration of an effective noise suppression will be covered in the next step of development.

28479 (BNL—34636) Secondary alkaline batteries. McBreen, J. (Brookhaven National Lab., Upton, NY (USA)). Mar 1984. Contract AC02-76CH00016. 39p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE84010963.

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This report on secondary alkaline batteries covers the overall reactions (charge/discharge characteristics), electrode structures and materials, and cell construction. The following batteries are studied, nickel oxide-cadmium, nickel oxide-iron, nickel oxide-hydrogen, nickel oxide-zinc, silver oxide-zinc, and silver oxide-cadmium, silver oxide-iron, and manganese dioxide-zinc batteries.

28480 (NP—4770259) Sealed Ni-Cd batteries with sintered electrodes for parallel stand-by service at normal and elevated temperatures. Raudszus, W. (Varta Batterie A.G., Hannover (Germany, F.R.)). 1982. 15p. (In German). NTIS (US Sales Only), PC A02/MF A01. Order Number DE84770259.

With some areas of application, for example data processing devices or emergency lightings, Ni/Cd accumulators with sintered electrodes are increasingly used for supplying these devices in cases of power outage. Frequently these devices and the batteries, too, will have to work at permanent temperatures of 40-45°C, with some applications at even higher temperatures. Whereas, at normal temperatures, cells of a conventional series make, type designations RS or RSH, will show a sufficient capacity output and service life in permanent charging with a constant current of $0.5xI_{10}$ ($0.05\ C_{10}A$), this will not hold good at more elevated temperatures. This led to the development of an improved series for utilization at higher temperatures, type designation RST. At 40°C permanent temperature and otherwise identical conditions, the novel cells have about the same service life as the conventional-series RS/RSH cells have at normal temperature. A further improvement of service life and charge uptake at all temperature ranges is possible by means of the introduction of another permanent charging method, i.e. by pulse charging. This charging method, a combined heavy charging/pulse-like permanent charging, can be introduced without any great additional expenditures and should be introduced with all important applications owing to its considerable advantages.

28481 **(PB—84-154848) Safety information profile: sli (starting, lighting, ignition) battery assembly.** Vandervort, R. (Radian Corp., Salt Lake City, UT (USA)). Apr 1979. 57p. NTIS, PC A04/MF A01.

A safety information profile is presented for the manufacturing of starting, lighting, and ignition lead acid storage batteries (Standard Industrial Classification 3691). Flow charts and process descriptions are offered for different types of batteries and operations. The primary hazard discussed is exposure to lead (7439921) with some attention paid to sulfuric acid (7664939) exposure. Current controls for chemical exposure and injury prevention are reviewed. Accident and illness information, and exposure levels are tabulated. Industry trends toward consolidation and production are summarized. Existing standards are listed. Names and addresses of industry associations and other interested parties are included. The results of this safety information profile indicate that newly instituted regulations regarding lead exposure will help alleviate this major hazard. Additional research is recommended to determine the effects of exposure to sulfuric acid. It is also advised that new industrial technology be monitored to control effectively any emerging potential hazards.

28482 **(SAND—83-2670) Quality control analysis of TA-23 glass seals for lithium ambient temperature batteries.** Nelson, C. (Sandia National Labs., Albuquerque, NM (USA)). Apr 1984. Contract AC04-76DP00789. 21p. NTIS, PC A02/MF A01; GPO Dep. Order Number DE84011719.

This study shows that large variations in glass composition, which severely reduces corrosion resistance, cannot be detected by measurements of physical properties. Chemical analyses are required to qualify a glass. Modest variations in the sealing and annealing temperatures do not affect the strength or corrosion resistance of the seal.

28483 **(SAND—84-0520C) Enhanced low-temperature performance of a multicell Li/$SOCl_2$ battery.** Street, H.K. (Sandia National Labs., Albuquerque, NM (USA)). 1984. Contract AC04-76DP00789. 8p. (CONF-840662—1). NTIS, PC A02/MF A01; GPO Dep. Order Number DE84011680.

From 31. NASA/US Army power sources symposium; Atlantic City, NJ, USA (11 Jun 1984).

The battery pack described in this report is a long-life, low-current, multi-tap power supply utilizing lithium thionyl chloride cells (LTC). This battery was developed to provide power to a portable solid-state recording accelerometer. The battery pack utilizes ten Li/$SOCl_2$ type LTC-7PN Keeper II cells. These cells are wired in a series-parallel arrangement to provide two 6-volt outputs and two negative 3-volt outputs with a single common. Additionally, four 301K ohm resistors are internally mounted and wired to permit an optional continuous 12 microampere current drain from the cells in order to eliminate voltage delay effects at very low temperatures. The pre-wired assembly is encapsulated, using Stepen Foam H-102N rigid polyurethane 2 lbs/ft^3 foam, molded to a density of 4 lbs/ft^3.

28484 **(SAND—84-0684C) Emerging battery technologies.** Chamberlin, J.L. (Sandia National Labs., Albuquerque, NM (USA)). 1984. Contract AC04-76DP00789. 13p. (CONF-8404142—1). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE84011193.

From Lead Industries/Zinc Institute joint meeting; Denver, CO, USA (3 Apr 1984).

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This report outlines emerging battery technologies. Included in this report are the following sections. The need for energy storage, the resulting programs, some results (lead-acid battery, zinc/chlorine battery and zinc/bromine battery) and the potential market. (CAS)

28485 **(SAND—84-7104) Testing, data analysis and engineering services on lead-acid load leveling batteries.** Sholette, W.P. (Exide Management and Technology Co., Yardley, PA (USA)). Apr 1984. Contract AC04-76DP00789. 42p. NTIS, PC A03/MF A01; GPO Dep. Order Number DE84011523.

As of December 31, 1983 eight 35-plate, advanced lead-acid, load-leveling cells have completed 1360 test cycles, two cycles per day. Discharging to a depth of 80% of the 5-h rated capacity (3100 Ah), their temperature remains at 39°C +- 5°. Capacity and energy output, measured by periodic 100%, depth-of-discharge, capacity-measuring cycles, has reached peak values for all cells. Also, deep-cycle accelerated tests at 70°C +- 5° were completed on the 10 longest-lived 17-plate cells; cycle life to 80% initial 5-h rated energy output ranged from 1174 to 1468 actual cycles (equivalent to 5940 to 7455 cycles at 25°C).

28486 **(TVA/OP/EDT—83/35) Battery test results on Gould GC2-EV200.** Blickwedel, T.W.; Hand, C.G. (Tennessee Valley Authority, Chattanooga (USA). Div. of Energy Demonstrations and Technology). Aug 1983. 100p. NTIS, PC A05/MF A01. Order Number DE84900635.

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This report describes the test and evaluation of Gould maintenance-free lead-acid eV batteries which were purchased by EPRI from Gould, Inc., and described as a new technology involving a starved electrolyte and semisealed construction. The modules were assembled at a Gould factory in Florida and shipped to the Gould Engineering Center at Rolling Meadows, Illinois, where they were acid impregnated and formed. Gould performed at least one test cycle on each module before shipping the modules to TVA for test and evaluation.

28487 **Membranes and separators for flowing electrolyte batteries-a review.** Arnold, C.; Assink, R.A. (Sandia National Laboratories Albuquerque, NM). *AIChE (American Institute of Chemical Engineers) Symposium Series;* **79**: No. 229, 197-204(1983).

Flowing electrolyte batteries are rechargeable electrochemical storage devices in which externally stored electrolytes are circulated through the cell stack during charge or discharge. The potential advantages that flow batteries offer compared to other secondary batteries include: 1) ease of thermal and electrolyte management, 2) simple electrochemistry, 3) deep cycling capability, and 4) minimal loss of capacity with cycling. However, flow batteries are more complex than other secondary batteries and consequently may cost more and may be less reliable. Flow batteries are being developed for utility load leveling, electric vehicles, solar photovoltaic and wind turbine application. The status of flow batteries has recently been reviewed by Clark et al. The flowing electrolyte batteries place rigorous demands on the performance of separators and membranes. The operating characteristics of the iron/chromium redox battery were changed in order to accommodate the limitations in membrane performance. Low cost alternatives to the presently used membrane must be found before the zinc/ferricyanide battery can be economically feasible. The zinc/bromine battery's efficiency could be improved if a suitably selective membrane were available. It is anticipated that better and less costly membranes to meet these needs will be developed as more is learned about their preparation and performance.

29 ENERGY PLANNING AND POLICY

REFER ALSO TO CITATION(S) 28523

28488 **(DOE/EIA—0204(84/02)) EIA publications. New releases.** (USDOE Energy Information Administration, Washington, DC). May 1984. 33p. NTIS, PC A03/MF A01; 1 - GPO; GPO Dep. Order Number DE84011809.

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This bimonthly report on available Energy Information Administration (EIA) publications and upcoming reports includes news about EIA, as well as many other items of special interest.

28489 **(GAO/RCED—84-34) DOE's defederalization of the Laramie and Grand Forks Energy Technology Centers.** (General Accounting Office, Washington, DC (USA). Resources, Community and Economic Development Div.). 16 Nov 1983. 23p. General Accounting Office, P.O. Box 6015, Gaithersburg, MD 20760. Order Number DE84901114.

In April 1983, the Department of Energy defederalized its government-owned and -operated energy technology centers at Laramie, Wyoming, and Grand Forks, North Dakota, by transfer-

ring the centers to the Universities of Wyoming and North Dakota, respectively. Cooperative agreements between the universities and DOE provide continued federal funding for fossil fuel research for up to 3-1/2 years at the centers. DOE also established project offices at each site to provide in part an ongoing federal management presence for the centers. GAO found that continued federal funding of the centers is legal. However, the level of funding negates any short-range budget savings which may have been anticipated; management of the centers is structured to ensure that both federal and university interests are considered in planning for center operations; reduction-in-force actions at the centers were carried out in accordance with Office of Personnel Management regulations. Most center employees were subsequently hired by the universities; and Public Law No. 97-394 specifically authorized the transfer of the federal property at the centers to the universities; other federal property laws do not apply.

28490 **(GAO/RCED—84-42) Energy Information Administration needs to strenghten its computer systems development procedures.** (General Accounting Office, Washington, DC (USA). Resources, Community and Economic Development Div.). 03 Jan 1984. 15p. General Accounting Office, P.O. Box 6015 Gaithersburg, MD 20760. Order Number DE84901113.

To strengthen system development procedures, GAO recommended development and implementation of specific procedures requiring that: a user-needs analysis be performed for systems development projects; and an appropriate management level conduct reviews when significant changes are made to the designs of the systems, and when planned costs or time frames are exceeded, or other significant problems are encountered.

28491 **(GAO/RCED—84-106) US Synthetic Fuels Corporation's contracting with individual consultants.** (General Accounting Office, Washington, DC (USA). Resources, Community and Economic Development Div.). 7 Feb 1984. 16p. General Accounting Office, P.O. Box 6015 Gaithersburg, MD 20760. Order Number DE84901108.

Report to the Chairman, Subcommittee on Oversight and Investigations, Committee on Energy and Commerce, House of Representatives.

The US Synthetic Fuels Corporation has an overall policy and implementing guidelines for awarding contracts. Regarding individual consultants, the policy states that contracts should be awarded on a competitive basis whenever practical and that noncompetitive procurements should be limited to time-critical situations and/or when the consultant has the unique expertise needed to perform the service. The guidelines, however do not require that these two conditions be met before awarding noncompetitive individual consultant contracts. Further, the corporation did not - as its guidelines require - compare consultants' charges with the cost of hiring permanent employees nor did it monitor consultants' performance. Without competition, consultant versus employee cost comparisons, and monitoring of performance the Corporation does not know whether it obtained the best person, price, or services. GAO is making recommendations for improvements in these areas.

2901 Energy Analysis And Modeling

REFER ALSO TO CITATION(S) 28542

28492 **(DOE/EI/06409—T2) Energy disaggregated input-output model. Model applications guide.** (CONSAD Research Corp., Vienna, VA (USA); Control Data Corp., Rockville, MD (USA)). 17 Jun 1981. Contract AC01-78EI06409. 165p. NTIS, PC A08/MF A01; 1; GPO Dep. Order Number DE84012405.

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The Energy Disaggregated Input-Output (EDIO) Model is an operational model maintained by the Macroeconomic Analysis Division of the Energy Information Administration, Department of Energy. The EDIO model describes interrelationships between sectors of the economy and is used to analyze the output and employment implications of alternative energy scenarios. The model is summarized according to its theoretical foundations, applications, limitations, and assumptions. The document provides a non-technical description of the model's analytical uses and guide to interpretation of model output. For a technical description of the software, data base, and computing environment of the model, the reader is referred to the EDIO Systems and Data Base Guide.

28493 **(DOE/EI/10562—T1-Vol.1) Overview of the 9 sector Dynamic General Equilibrium Model. Volume I. Final report .** Hudson, E.A. (Jorgenson (Dale W.) Associates, Cambridge, MA (USA)). Mar 1981. Contract AC01-79EI10562. 79p. NTIS, PC A05/MF A01; 1; GPO Dep. Order Number DE84005026.

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The 9 sector Dynamic General Equilibrium Model (9DGEM) is a model of the structure and growth of the U.S. energy and economic systems. This model was specified and constructed by Edward A. Hudson and Dale W. Jorgenson. 9DGEM has been installed on the EDS computer system of the Energy Information Administration and is available for use on this computer. The model is set up in a simulation program which permits projections and analyses to be performed over any interval within the 1948 to 2000 period. 9DGEM specifies five energy supplying sectors in addition to four non-energy producing sectors in representing the supply potential and structure of the economy. Capital, labor and productivity constraints are all included, as well as determination, from submodels of producer behavior, the patterns of inputs used in each type of production. Final demand is covered by a model of household behavior (covering consumption, labor supply and saving behavior) and also includes investment, government purchases and exports. The demand and supply aspects of the economy must be consistent; price and quantity adjustments bring about this consistency. This model can be used for energy and economic projections and it can be used for analyses.

28494 **(DOE/EI/10562—T1-Vol.2) Nine sector Dynamic General Equilibrium Model: specification and structure. Volume II. Final report .** Hudson, E.A. (Jorgenson (Dale W.) Associates, Cambridge, MA (USA)). Mar 1981. Contract AC01-79EI10562. 209p. NTIS, PC A10; 3; GPO Dep. Order Number DE84005336.

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The Dynamic General Equilibrium Model analyzes economic activity on a sectoral basis. It identifies 9 separate producing sectors in the domestic economy. Each of these sectors is represented by a sub-model of producer behavior. The household sector is also explicitly analyzed, not only in terms of its demand for the output of the producing sectors but also in terms of the supply of labor and the volume of saving. Part of the model is organized within an interindustry transactions framework. This permits balance and consistency between input and output patterns to be achieved over all intermediate and final goods markets. Another part of the model covers the supply of primary inputs, in particular of capital and labor, the demand for these inputs and the adjustment of activity patterns so that the input markets are in balance. The model also covers the growth of the economy over time with explicit attention given to savings and investment mechanisms and expansion of productive capacities through increases in capital and labor input and improvements in technical efficiencies. When all these components are integrated into a single, simultaneous system, the DGEM system, the result is a comprehensive analytical framework covering the structure of the economy at each point in time and its growth over time.

28495 **(DOE/EI/10562—T1-Vol.3) Econometrics and data of the 9 sector Dynamic General Equilibrium Model. Volume III. Final report .** Berndt, E.R.; Fraumeni, B.M.; Hudson, E.A.; Jorgenson, D.W.; Stoker, T.M. (Jorgenson (Dale W.) Associates, Cambridge, MA (USA)). Mar 1981. Contract AC01-79EI10562. 175p. NTIS, PC A08; 3; GPO Dep. Order Number DE84003394.

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This report presents the econometrics and data of the 9 sector Dynamic General Equilibrium Model. There are two key components of 9DGEM - the model of household behavior and the model of produconcrneer behavior. The household model is con-

cerned with decisions on consumption, saving, labor supply and the composition of consumption. The producer model is concerned with output price formation and determination of input patterns and purchases for each of the nine producing sectors. These components form the behavioral basis of DGEM. The remaining components are concerned with constraints, balance conditions, accounting, and government revenues and expenditures (these elements are developed in the report on the model specification).

28496 **(DOE/EI/10562—T1-Vol.4) Users guide to simulation with 9DGEM on the EIA/EDS computer. Volume IV. Final report.** Dorosh, P.A.; Hudson, E.A.; Parrish, J.E. (Jorgenson (Dale W.) Associates, Cambridge, MA (USA)). Mar 1981. Contract AC01-79EI10562. 48p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE84005358.

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DGEM has been assembled on the EIA/EDS system with ease of use a primary consideration. A JCL command procedure for running DGEM simulations is provided to the user. User input requirements are limited to a reasonably simple set of instructions which are handled completely by the command procedure provided. In addition, instructions for compiling and linking the Fortran codes are provided should the user desire to alter DGEM. Each of these procedures, user input requirements, and examples are given. The first section describes the simulation requirements for DGEM. The second section includes an example of the input runstream, the execute instructions, and a sample output. The third section specifies the use of the new technology sectors of the model. The fourth and fifth sections cover the use of the energy investment option and some applications of the investment linkages. The sixth section explains the way in which the program is altered and a new executable module is created. Finally, the last section describes certain deviations from the original DGEM documentation which have facilitated the use of DGEM on the EIA EDS system.

28497 **(DOE/EV/10316—1-Pt.1) Multiobjective power plant siting models: optimization, heuristic approaches and generating alternative configurations. Part I. Chapter I-V. Draft final report.** Church, R.L.; Bell, T.L.; Weaver, J. (Tennessee Univ., Knoxville (USA)). Jul 1983. Contract AS05-79EV10316. 146p. NTIS, PC A07/MF A01; 1; GPO Dep. Order Number DE84010858.

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A comparison of the baseline siting procedures of TEKNEKRON, INC. and Oak Ridge National Laboratory has been generated. Serious questions are raised as to the use and ability of the TEKNEKRON procedure in identifying reasonable configurations. A comparison of the scores used in the Oak Ridge and TEKNEKRON procedures has been completed on a common study area utilizing feasible cells generated by the Applied Physics Laboratory for the Mid Atlantic region. A siting heuristic (SELECT) designed to solve an integer-linear programming siting model similar to the APL-RELM model has been presented. Two procedures, Hop, Skip, and Jump (HSJ) and Push, Pull and Tug (PPT), have been utilized with both the Heuristic and Linear Programming approaches to generate close-to-optimal but significantly different power plant configurations.

28498 **(DOE/EV/10316—1-Pt.2) Multiobjective power plant siting models: optimization, heuristic approaches and generating alternative configurations. Part II. Chapter VI, references, appendices. Draft final report.** (Tennessee Univ., Knoxville (USA)). Jul 1983. Contract AS05-79EV10316. 140p. NTIS, PC A07; 3; GPO Dep. Order Number DE84010857.

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Several types of approaches have been suggested to generate alternatives to mathematical programming problems. These can be classified into two types: nonexhaustive and exhaustive generation techniques. Exhaustive techniques are those which find all close-to-optimal solutions to a given optimization problem. A nonexhaustive procedure is one which may or may not find all close-to-optimal solutions. For some problems, an exhaustive alternative genertion procedure may not be an appropriate one. There are, for example, an infinite number of solutions within a certain percentage of optimality for a linear programming problem and it would be impossible as well as foolhardy to suggest generating all of them. It would be interesting, however, to identify the convex hull containing all solutions within a certain percentage of optimality for such a problem. For finite problems, e.g., a combinatorial problem, the concept of an exhaustive generation scheme used in defining all close-to-optimal solutions is easily understood.

28499 **(EPRI-EA—3482) Role of energy in productivity growth. Final report.** Jorgenson, D.W. (Jorgenson (Dale W.) Associates, Cambridge, MA (USA)). May 1984. 59p. EPRI-RRC, Box 50490, Palo Alto, CA 94303. Order Number DE84920356.

The objective of this paper is to analyze the role of energy in the growth of productivity. For this purpose we develop and implement a new econometric model of productivity growth. We have estimated the unknown parameters of this model from data for thirty-five individual industries of the United States for the period 1958 to 1979. Our econometric model determines the growth of sectoral productivity as a function of the relative prices of sectoral inputs. To capture the impact of electrification we have divided inputs for each sector among capital, labor, electricity, nonelectrical energy, and materials inputs.

2902 Economics And Sociology

REFER ALSO TO CITATION(S) 27837, 27878, 27879, 28294, 28492, 28506, 28511, 28537, 28538, 28595, 29315, 30058

28500 **(DOE/CS/20448—T2) Briefing materials on FmHA 601 Energy Impact Assistance Program.** (Resource Planning Associates, Inc., Washington, DC (USA)). 17 Oct 1979. Contract AC01-78CS20448. 41p. NTIS, PC A03; 3; GPO Dep. Order Number DE84010739.

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Legislative history of the legislation is addressed through: allocation formula; application procedures; budget; comparison with current programs; designated impact areas; DOE responsibility; eligibility criteria; eligible projects; federal and state responsibility of Farmers Home Administration; funding allocations by state; key issues; administration and program status. (PSB)

28501 **(DOE/PE/06419—T4) Alternative work schedules energy conservation potential. Task II report.** (Peat, Marwick, Mitchell and Co., Washington, DC (USA); Faucett (Jack) Associates, Inc., Chevy Chase, MD (USA); Georgetown Univ., Washington, DC (USA)). 27 Jul 1979. Contract AC01-78PE06419. 61p. NTIS, PC A04/MF A01; GPO Dep. Order Number DE84006090.

This report includes: institutional, technological, and attitudinal factors affecting alternative work schedules (AWS) use; most likely variations of AWS use and projections of AWS use; and refinements to the analytical frameworks for the assessment of transportation- and non-transportation-related energy impacts. A considerable amount of research has been completed concerning the analysis of current alternative work schedule history and experiences. Particular emphasis has been placed on identifying factors that affect the adoption and use of alternative work schedules. This research on factors affecting use has been used to make projections for future AWS use. In many cases data were not available to make solid projections, and best guesses were made. Finally, the analytical framework for analyzing both transportation-related energy impacts and non-transportation-related energy impacts has been included in this report. Only the refinements to the basic framework are discussed in this report.

28502 **(EPRI-EA—3462) Industrial energy substitution: econometric analysis of US data, 1958 to 1974. Final report.** Hazilla, M.; Kopp, R.J. (Resources for the Future, Inc., Washington, DC (USA)). Apr 1984. 440p. EPRI-RRC, Box 50490, Palo Alto, CA 94303. Order Number DE84920319.

In this project industrial activity is modeled at a disaggregate level. Econometric models are developed for several sectors: agriculture, 4 resource extraction sectors, construction, 21 manufacturing sectors, 4 service sectors, and 2 public utilities. Also, tests

are conducted to determine the sensitivity of results to the theoretical, empirical, and data research decisions made in the course of the study. Project results highlight the heterogeneous nature of production sectors with respect to energy substitution. There is no strong evidence to suggest that the economy as a whole is dominated by either capital-energy complementarity or substitution. Results indicate that agriculture is characterized by energy-capital complementarity; 3 resource extraction sectors display complementarity and 1 displays substitution; construction displays substitution; 10 manufacturing sectors are characterized by complementarity, 9 by substitution, and 2 by ambiguity; and services and utilities are dominated by substitution. A similarly heterogeneous pattern of association is also found among energy and labor and intermediate inputs.

28503 **(GAO/NSIAD—83-52) Administration knowledge of economic costs of foreign policy export controls.** (General Accounting Office, Washington, DC (USA). National Security and International Affairs Div.). 2 Sep 1983. 50p. General Accounting Office, Box 6015, Gaithersburg, MD 20760. Order Number DE84901124.

Report to Senator Charles H. Percy.

The Export Administration Act of 1979 requires consultation, as appropriate, with businesses affected by proposed controls and consideration of the controls economic impact. GAO found that although there was minimal formal business consultation, the business community and the Commerce and State Departments did provide decision-makers with the essential economic arguments against the use of export controls. Administration economic analyses usually did not provide estimates of the controls indirect effects, but important limits exist to Commerce's ability to better quantify such economic costs. GAO's review does not support the conclusion that the administration might have acted differently had it been aware of the total economic costs, and it shifts the debate back to the usefulness of such foreign policy controls.

28504 **LLNL in the developing Livermore Valley.** *Energy Technology Review;* 14-23(Apr 1984).

A series of aerial photographs highlights fifty years of development in the Livermore Valley and illustrates the trend of urban enroachment into the land surrounding the Laboratory.

28505 **Interdisciplinary approach to cost/benefit analysis of innovative electric rates.** Berg, S.V.; Capehart, B.L.; Feldman, J.; LaTour, S.; Sullivan, R.L. (Univ. of Florida, Gainesville). *Resources and Energy;* 5: No. 4, 313-330(Dec 1983).

Contributions from many disciplines must be incorporated in a comprehensive framework if cost/benefit analysis is going to be both rigorous analytically and convincing to utility managers and regulators. This paper describes a new class of software tools available for evaluating the impact of innovative electric rates. The components on one such simulation model are briefly described and sample results presented. The policy recommendations that emerge from these simulation studies have important implications for the regulatory process, including the division of labor between regulators and companies, level of detail (and realism) needed to support proposed policies, and criteria for evaluating alternative scenarios. Although sophisticated methodologies can be a catalyst for improved decision-making in the electric utility industry, they may raise more issues than they resolve. 20 references, 2 figures, 1 table.

2903 Environment, Health, And Safety

REFER ALSO TO CITATION(S) 29213, 29224, 29229, 29251, 29267, 29295, 29305, 29514

28506 **(CONF-840418—1) Implications of air quality planning programs on regional energy use.** Hunsaker, D.B. Jr. (Oak Ridge National Lab., TN (USA)). Apr 1984. Contract AC05-84OR21400. 8p. NTIS, PC A02/MF A01; GPO Dep. Order Number DE84011462.

From 30. annual technical meeting on environmental integration technology today for a quality tomorrow; Orlando, FL, USA (30 Apr 1984).

A topic of much debate in recent years has been the potential conflict between protection of the environment and the conservation of nonrenewable imported energy resources. The goals of air pollution control programs can be realized more readily if they are compatible with energy conservation goals. This study attempts to give insight on the above issue by conducting a retrospective analysis of the energy consequences of implementing the 1979 San Francisco Bay Area Air Quality Plan. The energy consumed or saved on a regional basis through compliance with pollution control actions stemming from the Plan is estimated, and is then compared to the total energy consumed during the same time frame by the appropriate sector of the economy. For example, industry compliance with regulations related to the new source review policy action resulted in an estimated regional energy penalty equivalent to less than 1% of the energy consumed by the commercial and industrial sectors of the Bay Area economy. On the whole, the 1979 Plan was estimated to produce a slight overall energy savings, primarily due to hydrocarbon emission controls on stationary and mobile sources. Places in the air quality regulatory framework that address energy issues are identified; recommendations are made for modifying the framework to encourage the consideration of energy issues while still meeting the goals of the Clean Air Act. 17 references, 3 tables.

28507 **(CONF-840612—8) Estimating air quality impacts and associated costs of achieving alternative national ambient air quality standards for particulate matter.** Smith, A.E.; Brubaker, K.L. (Argonne National Lab., IL (USA)). 1984. Contract W-31-109-ENG-38. 21p. NTIS, PC A02/MF A01; GPO Dep. Order Number DE84011708.

From Air Pollution Control Association annual meeting; San Francisco, CA, USA (25 Jun 1984).

Paper No. 84-109.6.

This paper describes a nationwide analysis of the costs and air quality impacts of alternative NAAQS for particulate matter (PM). The analysis was undertaken in support of the required RIA. Results of this work were used directly in the RIA itself and also provided cost and air quality data used to analyze the benefits associated with attaining the alternative standards. 7 references, 2 figures, 3 tables.

28508 **(CONF-8404145—1) Siting energy projects: the need to consider cumulative impacts.** Reed, R.M.; Webb, J.W.; Cada, G.F. (Oak Ridge National Lab., TN (USA)). Apr 1984. Contract AC05-84OR21400. 14p. NTIS, PC A02/MF A01; GPO Dep. Order Number DE84011641.

From Energy and environment symposium on facility siting and routing; Banff, Alberta, Canada (15 Apr 1984).

Although regulations for implementing the National Environmental Policy Act identify the need to assess cumulative impacts (i.e., incremental impacts of overall development in the affected region) associated with federal funding or approval of major actions, most federal studies devote minimal attention to this topic. A review of environmental impact statements on energy projects found that most analyses of cumulative impacts were written in very general terms, presented few data to support these general conclusions, and appeared to have had little influence on the selection of the environmentally preferred site. Nevertheless, analyses of cumulative impacts can and should be undertaken as an important part of the evaluation of project impacts. We include recommendations on the types of information and analyses that should be used in evaluating the cumulative effects of siting energy projects. 11 references, 1 table.

28509 **(DOE/BP—259) Annual environmental report.** (Bonneville Power Administration, Portland, OR (USA)). 1983. 38p. NTIS, PC A03/MF A01; GPO Dep. Order Number DE84012152.

In order to provide BPA's management with environmental information for decisionmaking and to comply with the National Environmental Policy Act of 1969 (NEPA), in 1983 BPA completed 5 Environmental Impact Statements (EIS's) and 12 Environmental Asessments (EA's). BPA also responded to and complied with various other applicable environmental mandates including various pollution control laws and regulations and natural resource protection requirements. In addition, BPA continued to make progress on implementing environmental provisions of the Pacific Northwest Electric Power Planning and Conservation Act (PNEPPCA) including responsibility to fund and implement major parts of the Co-

lumbia Basin Fish and Wildlife program developed by the Pacific Northwest Regional Power Planning Council.

28510 **(PNL-SA—11980) Impacts of acid deposition on regional economic activity.** Adams, R.C.; Moe, R.J. (Pacific Northwest Lab., Richland, WA (USA)). Jan 1984. Contract AC06-76RL01830. 10p. (CONF-840269—8). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE84011268.

From NAPAP Task Group G peer review meeting; Burlington, VT, USA (14 Feb 1984).

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Acid deposition reduction and mitigation policies will change the welfare of individuals who consume and/or produce the goods and services affected by the policy. Such changes may take the form of benefits, which are associated with the values society places on policy-induced reductions in acid deposition damages. Conversely, they may take the form of costs, which are associated with the values society places on inputs used to effect the change. In addition, acid deposition policies may result in changes in regional employment, income, and other measures of economic activity. Policy-induced changes in crop and timber yields, recreational activity, production of emission control equipment and other machinery, coal production, and electricity prices may cause direct employment and earnings changes in the associated industries, as well as indirect employment and earnings changes in closely related industries. A methodology to assess the direct, indirect, induced, and total impacts of acid deposition reduction and mitigation policies on regional economic activity will be developed. The methodology will utilize the Pacific Northwest Laboratory Metropolitan and State Economic Regions (MASTER) model, which forecasts economic activity and policy impacts on economic activity in all 312 Metropolitan Statistical Areas and 48 non-MSA Rest-of-State Areas in the continental United States. Two extensions will be developed. First, 6 of the industries considered in MASTER will be disaggregated, resulting in a 36-industry model. This will increase the accuracy of estimates of impacts. Second, employment/production relationships in each of the industries affected by deposition policies will be estimated. Finally, the impacts on regional economic activity of four proposed policies will be estimated.

2904 Natural Resources

REFER ALSO TO CITATION(S) 27711, 28517, 28560

28511 **(DOE/NBM—84010611) Acquiring water for energy: institutional aspects.** Weatherford, G.; Nardi, K.; Osterhoudt, F.; Roach, F. (eds.). (Muir (John) Inst., Inc., Napa, CA (USA). Center for Natural Resource Studies). 1982. Contract W-7405-ENG-36. 289p. NTIS, PC A13/FM A01; 1; GPO Dep. Order Number DE84010611.

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This book provides basic information about the legal, political and social constraints faced by energy developers in the acquisition of water. It is a guide to those institutional constraints which are general and pronounced enough to be important for regional assessments. It is not a manual for facility siting or site-specific assessments. Only the acquisition phase of the water use cycle is emphasized. The study focuses primarily on legal constraints and secondarily on political constraints, because they tend to encompass or reflect other forms of institutional constraints such as economic ones. 11 figures, 9 tables.

28512 **(NP—4900941) West Virginia mineral producers and processors directory.** Kirstein, D.S.; Simcoe, N.L. (comps.). (West Virginia Geological and Economic Survey, Morgantown (USA)). Sep 1983. 186p. WVGES, Mont Chateau Research Center, Morgantown, WV. Order Number DE84900941.

Statistical data on the amount, value, and distribution of mineral production in West Virginia for 1982 is presented. Coal, oil, gas, and stone were the most common and widespread extracted mineral resources. (ACR)

28513 **(TVA/PUB—84/36) Cost of owning and operating a 9-32-0/10-34-0 facility.** Williams, R.J. (Tennessee Valley Authority, Muscle Shoals, AL (USA). Office of Agricultural and Chemical Development). Apr 1984. 22p. NTIS, PC A02/MF A01. Order Number DE84901244.

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This analysis specifies the relative economics of a 20-ton per hour combination 9-32-0/10-34-0 plant for a midwest location. The major points are: (A) Initial investment in on-site plant and equipment ranges from $192,000 to $242,000 (excluding storage costs) depending on use of fluid clay or dry clay respectively. Storage costs are a major cost outlay depending on scheduling of raw materials and final products. When storage and off-site costs such as truck scales, office building, and spare parts inventory were added, initial investment was from $356,000 (using fluid clay) to $406,000 (using dry clay). Since storage costs may be conservative, a total investment of $450,000 to $500,000 appears reasonable for planning purposes. (B) Annualized costs show raw materials as the predominant cost factor. For a 20-ton per hour plant, operated between 5000 tpy and 11,000 tpy, raw materials cost account for 81 to 89 percent of total annual costs. (C) Expected delivered phosphoric acid prices (1984) used in the analysis were $3.65 per unit (Ortho) and $4.56 per unit (Super). With a 60/40 annual production ratio in producing 10-34-0/9-32-0, the weighted break-even price ranged from $202 per ton for a 5000 tpy volume to $184 per ton for an 11,000 tpy volume. When revenues for the final product were set at $210 per ton for 10-34-0 and $183 per ton for 9-32-0, the breakeven volume was between 5000 and 6000 tons per year. As price estimates for the final products go down, this break-even volume will increase if everything else remains the same. (D) Although these estimates suggest economic feasibility for volumes above the breakeven point, this feasibility is highly sensitive to raw material cost and final product prices. Thus, quotes on prices and tonnages should not be divorced from assumptions on raw materials and revenues. 1 reference, 2 figures, 6 tables.

28514 **Future for minerals in the world market.** Chiles, J.H. III. (Dept. of Energy, Washington, DC). pp 11-20 of International conference on coal, minerals and petroleum. Anchorage, AK; Resource Development Council for Alaska, Inc. (1983). (CONF-830251—).

From International conference on coal, minerals and petroleum; Anchorage, AK, USA (16 Feb 1983).

This article discusses the Department of Energy's (DOE) views on the economic development of our country's supply of fuel and non-fuel mineral resources and lessons learned and applied in formulating our national energy policy. The policy of DOE is to remove regulatory rigidities and other impediments to fluid market responses to supply and demand changes through adjustments in the price structure. Presented was the role of the government policy on: land use issues, import dependency, strategic stockpiling, and research and development.

2905 Research, Development, Demonstration, And Commercialization

REFER ALSO TO CITATION(S) 28036, 28513, 28544

28515 **(DOE/ER/10125—T1) Exploratory energy research program at the University of Michigan.** (Michigan Univ., Ann Arbor (USA)). May 1984. Contract FG02-80ER10125. 64p. NTIS, PC A04/MF A01; GPO Dep. Order Number DE84012401.

A DOE grant of $550,000 to the University of Michigan for an Exploratory Energy Research Program was administered by the U-M Office of Energy Research (OER) to support faculty research, graduate student research assistantships, and other matters pertaining to energy research at the U-M. This final report describes activity during the four years of the program, and presents brief summary reports on the 73 energy-related research projects carried out by faculty in the physical, engineering, biological, and behavioral sciences.

28516 **(GAO/RCED—84-30) Long-term plan is needed to guide DOE and multiprogram laboratory research and development activities.** Peach, J.D. (General Accounting Office, Washington, DC (USA). Resources, Community and Economic Development Div.). 16 Jan 1984. 9p. General Accounting Office, P.O. Box 6015, Gaithersburg, MD 20760. Order Number DE84901111.

Effective planning is needed to guide decisionmaking in any large and complex program that expends billions of dollars each year, offers uncertain results, and must choose among alternatives that compete for limited federal funding. The objectives of our review were to determine whether DOE provided sufficient planning direction to its laboratories and whether that direction was based on its long-term research and development goals, objectives, and priorities. GAO concluded that a long-term plan is needed for DOE's energy research and development work because new energy technologies often extend over several years, and facilities and other resources must be planned and acquired before work can begin. In addition, congressional and executive branch decisionmakers need planning details on the anticipated results and potential impact of funding for future energy technologies. Likewise, the multiprogram laboratories must know what DOE intends to accomplish over time because DOE relies on these laboratories to identify and carry out its research and development projects. Recommendations were included.

28517 **(NP—4901257) Florida energy research and development index.** (Florida Energy Research and Development Task Force, Tallahassee (USA)). May 1984. 215p. NTIS, PC A10/MF A01. Order Number DE84901257.

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Persons, organizations, and types of energy research occurring in Florida are referenced. The 333 entries are grouped into seven categories: (1) conservation and cogeneration; (2) electrical, nuclear, and physical; (3) transportation; (4) renewable resources; (5) fossil resources; (6) social sciences and modeling; and (7) environmental, genetic, and chemical. Only current projects and those completed since mid-1982 are listed. The greatest number of projects fall into the renewable resources category, including solar energy and biomass resources. More than 50 projects are conservation and environmental. Other areas include nuclear reactor safety, enhanced oil recovery, acid precipitation, and coal slurries, gasification, and combustion. The number of energy research projects in each category are indicated in graphic form.

28518 **(PB—84-154293) Current alternative energy research and development in Illinois.** Swager, R. (Illinois Dept. of Energy and Natural Resources, Springfield (USA)). Dec 1983. 219p. NTIS, PC A10/MF A01.

See also PB83-228478.

This Directory is intended to acquaint researchers, policy makers and citizens with recent activities in alternative energy research, development and demonstration projects. The topics covered have been limited to those concerned with the development of non-fossil, non-nuclear energy sources. Included are projects in process in Sept. 1983 or that had been completed after May 1983. It attempts to include projects performed by Illinois organizations, both within the state and out-of-state, and projects performed by out-of-state organizations at sites within Illinois.

28519 **Assessing the alternative fuels production program.** Doucette, D.B. *Energy Research Reports;* **10**: No. 2, 1-7(30 Jan 1984).

Despite some successes in synthetic fuels development, the $2.2 billion Alternative fuels Program is disappointing in that few of the preliminary analyses will lead to commercial projects. The economics of surplus oil at soft prices and the benefits of energy conservation have taken away the urgency of both this program and the Synthetic Fuels Corporation. A summary of the feasibility studies and cooperative agreements carried out under the Alternative Fuels Program coves alcohol fuels, biomass, coal gasification and liquefaction, oil shale, tar sands, unconventional gas resources, peat, and solid waste conversion. The summary includes a budget breakdown and a status report of each.

28520 **Science and technology: cooperation between and United States and China. Hearings before the Special Subcommittee on US Trade with China, Ninety-Eighth Congress, first session, October 31, November 3, 1983.** Washington, DC; Government Printing Office (1984). 328p. GPO.

Eleven witnesses from various agencies involved in technology transfer agreements with China testified at two days of hearings on cooperative efforts that have led to 20 signed protocols. The witnesses were asked to review the history of these protocols and to identify areas of progress as well as those where problems exist. Participants in the effort include the Departments of State, Commerce, Transportation, and Energy, the National Institutes of Health, the National Aeronautics and Space Administration, and the US-People's Republic of China environmental protection protocol. Additional material supplied for the record and an appendix reproducing the 20 protocols follows the testimony.

2906 Nuclear Energy

REFER ALSO TO CITATION(S) 27897, 27968, 27988, 28271, 28538

28521 **(DOE/NE—0048/5) UPDATE. Nuclear power program information and data, October-December 1983.** Griffith, J.D. (Department of Energy, Washington, DC (USA). Assistant Secretary for Nuclear Energy). Mar 1984. 116p. (PB—84-911504). NTIS, PC A06/MF A01; 1; GPO Dep. Order Number DE84010683.

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UPDATE is published to provide a quick reference source on the current status of nuclear powerplant construction and operation in the United States and for information on the fuel cycle, economics, and performance of nuclear generating units. Similar information on other means of electric generation as related to nuclear power is included when appropriate. UPDATE is intended to provide a timely source of current statistics, results of analyses, and programmatic information proceeding from the activities of the Office of Nuclear Energy and other components of the Department of Energy, as well as condensations of topical articles from other sources of interest to the nuclear community. It also facilitates quick responses to requests for data and information of the type often solicited from this office.

28522 **(GAO/RCED—84-64) DOE's allocation of costs for uranium enrichment services.** (General Accounting Office, Washington, DC (USA). Office of the Comptroller General). 15 Nov 1983. 13p. General Accounting Office, P.O. Box 6015 Gaithersburg, MD 20760. Order Number DE84901118.

In order to more fairly price uranium enrichment services, GAO recommended that DOE account separately for the costs of providing high and low enrichment services and using such cost information, establish separate enrichment prices for each customer. Audits occured in Maryland, Tennessee and Kentucky.

28523 **(GAO/RCED—84-74) Impact of international cooperation in DOE's magnetic confinement fusion program.** (General Accounting Office, Washington, DC (USA). Resources, Community and Economic Development Div.). 17 Feb 1984. 25p. General Accounting Office, P.O. Box 6015, Gaithersburg, MD 20760. Order Number DE84901120.

Report to the Honorable Fortney H. Stark, Jr., House of Representatives.

The US fusion community participates in many cooperative projects with other countries conducting research in fusion energy - a new potential source of virtually unlimited nuclear power. Many of these projects involve routine exchanges of information. Others are pursued under formal agreements that allow US and foreign scientists to participate in research at US and foreign fusion facilities and may involve the contribution of funds and/or equipment. US fusion energy experts believe that international cooperative efforts benefit all participants and contribute to the advancement of US fusion research objectives. International cooperative efforts, of themselves, do not directly affect the US leadership position in fusion energy. Because fusion energy is in such an early stage of

development, it is unlikely that any country could obtain a commercial advantage from information obtained from ongoing international cooperative efforts.

28524 **(IFEU—24) Comparing the risk: nuclear energy, coal, natural radioactivity.** Teufel, D. (Institut fuer Energie- und Umweltforschung e.V., Heidelberg (Germany, F.R.)). May 1983. 187p. (In German). Institut fuer Energie- und Umweltforschung e.V., Heidelberg (Germany, F.R.).

A summary of a two-year research programme containing the results and most important information of the final report. Eight different models for assessment and evaluation of the risks of technologies are described and analysed. These are (selection): - the comparison of emissions, - the dilution model, - the compartment model. All risk models are applied in practice to various energy technologies. The frequently arising problems are descirbed for example: - if models are applied for situations and comparisons where the application is not permissible. The non-permissible application of certain model means that - risks for everybody, - ecological risks, - delayed risks are systematically underestimated.

28525 **(INIS-mf—8720) Annual report 1982 of Deutsches Atomforum.** (Deutsches Atomforum e.V., Bonn (Germany, F.R.)). 1983. 62p. (In German). NTIS (US Sales Only), PC A04/MF A01. Order Number DE84780218.

The organization and the activities of this institution in general as well as the activities in 1982 in the following fields are reported: engineering and industry public relations and press, law and administration, economy and industry, international cooperation. (UA).

28526 **(NUREG—0540-Vol.6-No.1) Title list of documents made publicly available, January 1-31, 1984. Vol. 6, No. 1.** (Nuclear Regulatory Commission, Washington, DC (USA). Div. of Technical Information and Document Control). Apr 1984. 593p. NTIS, PC A25/MF A01 - GPO*. Order Number DE84901205.

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The Title List of Documents Made Publicly Available is a monthly publication. It contains descriptions of the information received and generated by the US Nuclear Regulatory Commission (NRC). This information includes (1) docketed material associated with civilian nuclear power plants and other uses of radioactive materials and (2) nondocketed material received and generated by NRC pertinent to its role as a regulatory agency. As used here, docketed does not refer to Court dockets; it refers to the system by which NRC maintains its regulatory records. This series of documents is indexed by a Personal Author Index, a Corporate Source Index, and a Report Number Index. The documents referenced in this issue were made available in January, 1984.

28527 **(NUREG—0540-Vol.6-No.2) Title List of Documents Made Publicly Available.** (Nuclear Regulatory Commission, Washington, DC (USA). Div. of Technical Information and Document Control). Feb 1984. 667p. NTIS, PC A99/MF A01 - GPO*. Order Number DE84901095.

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The Title List of Documents Made Publicly Available is a monthly publication. It contains descriptions of the information received and generated by the US Nuclear Regulatory Commission (NRC). This information includes (1) docketed material associated with civilian nuclear power plants and other uses of radioactive materials and (2) nondocketed material received and generated by NRC pertinent to its role as a regulatory agency. As used here, docketed does not refer to Court dockets; it refers to the system by which NRC maintains its regulatory records. This series of documents is indexed by a Personal Author Index, a Corporate Source Index, and a Report Number Index. This index covers February 1984.

28528 **(PB—84-157817) Soviet programme for peace and the West European peace movements.** Skak, M. (Foersvarets Forskningsanstalt, Sundbyberg (Sweden)). [nd]. 80p. (FOA-C—10225-M3). NTIS, PC E05/MF E01.

Text in English with Swedish Abstract.

Lately the questions of peace have come to play an important role in the security policy debate. This study deals with the Soviet peace campaign as well as the West European peace movements ambitions and relations to Moscow. An analysis of alternative European developments is also included.

28529 **Stabilizing Star Wars.** Weinberg, A.M.; Barkenbus, J.N. (Oak Ridge Associated Univ., TN). *Foreign Policy;* No. 54, 164-170(1984).

An orderly replacement of offensive with defensive nuclear weapons is part of the defense-protected build-down (DPB) strategy described by Weinberg and Barkenbus. Differing from the administration's Star Wars approach by relying on interceptor missiles rather than costly and unproven lasers and particle beams, the plan also calls for a simultaneous freeze on offensive weapons. (DCK)

28530 **IAEA efforts to improve nuclear power plant operational safety.** Epel, L.G. (Brookhaven National Lab., Upton, NY); Franzen, L.F.; Osmachkin, V. (International Atomic Energy Agency, Vienna, Austria). *International Atomic Energy Agency Bulletin;* **25**: No. 3, 6-10(Sep 1983).

The IAEA has for many years supported programmes aimed at strengthening the operational safety of nuclear power plants. It has done this in three ways: by developing Safety Standards and Guides, by sponsoring vehicles for information exchange, and by providing various advisory services. Two relatively new programmes have led to the establishment of Operational Safety Review Teams, and of the Incident Reporting System. The IAEA activity to improve nuclear power plant operational safety is briefly reviewed in the article.

28531 **Nuclear power: epilogue or prologue?.** Denton, H.R. (Nuclear Regulatory Commission, Washington, DC). *Energy Journal;* **4**: No. 1, 125-141(Jan 1983).

Several failures in technology assessment, notably the failure to solve the waste management and public relations problems, make it difficult to forecast the future of nuclear power in the US. Using a probability approach, this paper deals with the economic, social, and political factors which affect nuclear power plant investment choices and the probability of certain events, such as reactor accidents, policy shifts, and technological breakthroughs to develop a pessimistic (epilogue) and optimistic (prologue) scenario of the future of nuclear energy. The conclusion is that preserving the nuclear option will require a great deal of effort to overcome the current uncertainties. 35 references, 1 table.

2907 Transport And Storage

REFER ALSO TO CITATION(S) 27823, 27824, 27968, 28540

28532 **(EPRI-EL—3106-Vol.4) Power line-induced ac potential on natural gas pipelines for complex rights-of-way configurations. Volume 4. Field verification of horizontal wire mitigation method. Final report.** Frazier, M. (Science Applications, Inc., Schaumburg, IL (USA)). Apr 1984. 94p. EPRI-RRC, Box 50490, Palo Alto, CA 94303. Order Number DE84920344.

The joint use of common corridors for overhead electric power transmission lines and buried natural gas transmission pipelines is increasing. While many benefits accrue from the sharing of corridors, the coupling of electromagnetic energy onto the natural gas transmission pipelines is an undesired consequence of this joint usage. The steady-state pipeline voltage that can result may require mitigation as a safety measure. Many common corridors include multiple power lines and pipelines with complexities such as bonds or crossovers between the pipelines and terminating pipelines or insulators. This project has resulted in the development of the methodology and techniques for analyzing such complex common corridor coupling problems. Field tests were conducted to verify key aspects of the analysis.

2908 Waste Heat Utilization

REFER ALSO TO CITATION(S) 28668, 28687

28533 (BMFT-FB-T—83-296) Investigations specific to qualifications for the further development of district-heating pipes. Brachetti, H.E.; Bek, S.; Lin, P.; Westhoff, H. (Bundesministerium fuer Forschung und Technologie, Bonn (Germany, F.R.)). Dec 1983. 95p. (In German). NTIS (US Sales Only), PC A05. Order Number DE84751225.

Paper copy only, copy does not permit microfiche production; With 7 refs., 3 tabs., 36 figs.

The researchings attained the end, to develop testing operations especially on simplified district-heating-pipesystems. They started to make qualifications on mineral-fibre-insulations by testing seven special products. The cooking test for complete insulation shells has found out a simple method of qualification on persistance of heat-loss. The qualification of directly earth-laid heat-pipes had been developed by the water-space-testing-unit and the soil-box-testing-unit. Water-space tests are especially qualified for finding out weak-points of the heating-pipe-systems. The soil-box-test is a permanence-stress-test. During 5 years about 138 long-time-tests on different systems of heat-pipe-joints have been made to get higher qualities on 10 pipe-systems. 16 special manufacturers of these products have joined the testing operations. The qualification-tests are able to find out results for going on in development.

2910 Conservation

REFER ALSO TO CITATION(S) 28596, 28668, 28712

28534 (IIES-dp—83-4) Consumer energy conservation policies in Australia. Crossley, D.J. (Wissenschaftszentrum Berlin (Germany, F.R.). Internationales Inst. fuer Umwelt und Gesellschaft). 1983. 129p. NTIS (US Sales Only), PC A06/MF A01. Order Number DE84751506.

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Two factors are essential to bear in mind when considering consumer energy conservation policies in Australia. First, responsibility for energy matters is divided between the Commonwealth (Federal) Government and State governments. Second, in comparison with many other countries, there is a relatively low level of activity in Australia in the area of promoting energy conservation by consumers. The characteristics of consumer energy conservation in Australia can be summarised fairly briefly. Most of the activities in this area, with the exception of the governmentsponsored National Energy Conservation Program, are discrete, ad hoc, and uncoordinated with respect to other similar activities. In fact, there are few fully-fledged consumer energy conservation programmes, and most activities can only be described as "initiatives". The major policy actors and sponsors of energy conservation initiatives are governments, together with some government-owned energy utilities. There are three reasons for the fairly limited development of energy conservation policies in Australia. First, shortages of energy are experienced as being temporary. Second, linkages between energy conservation policies and consumer and environmental policies are weak. Third, there has been no public debate about nuclear power in Australia.

28535 (IIES-dp—83-5) Consumer energy conservation policies in Sweden. Klingberg, T. (Wissenschaftszentrum Berlin (Germany, F.R.). Internationales Inst. fuer Umwelt und Gesellschaft). [nd]. 248p. NTIS (US Sales Only), PC A11/MF A01. Order Number DE84751474.

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In 14 chapters nine authors describe and discuss various aspects of Swedish energy conservation policy directed at the residential sector. The development of the energy policy since World War 2 is reviewed as well as the present policy. Several chapters deal with various policy instruments aimed at promoting energy conservation. Descriptions of regulations, the government financial incentive system and the advisory services are presented. Effects of these programm strategies are discussed in view of some recent evaluations. The local autorithies which have been assigned the responsibility of the implementation at the communal level may be the key to energy conservation in Sweden. Their role is described. The development in the energy field is connected to both consumer interest and environmental protection. These ties are treated in three chapters. Thoughts on the development of research and energy policy with regard to conservation form the conclusion. In a separate section of the study, selected Swedish residential energy statistics compiled for the consumer energy conservation policies (CECP) are presented.

2920 Supply, Demand, And Forecasting

REFER ALSO TO CITATION(S) 27836, 28537, 28709

28536 (NP—4770272) Energy report Bavaria 1981. (Bayerisches Staatsministerium fuer Wirtschaft und Verkehr, Muenchen (Germany, F.R.)). Dec 1982. 114p. (In German). NTIS (US Sales Only), PC A06/MF A01. Order Number DE84770272.

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After a report on the energy industry in Bavaria in 1981, some explanations on the energy balance are given which is then shown in tabular form. In an extensive tabular part, the development and structure of the primary and final energy consumption and, under a special aspect, the situation and development of the individual energy sources are described. The appendix contains the answers of the Bavarian State Minister of Economy and Traffic and the State Secretary in the Bavarian State Ministry of Economy and Traffic to written inquiries of the Members of the Bavarian Landtag.

2930 Policy, Legislation, And Regulation

REFER ALSO TO CITATION(S) 28250, 28520, 28528, 28529, 28554, 29229, 29267

28537 Scoreboard on energy predictions. *Energy Economics, Policy and Management;* **3**: No. 3, 35-42(1984).

An abstract from DOE's "Energy Projections to the Year 2000 - a Technical Report in Support of the National Energy Policy Plan" lists past successes and failures in energy predictions. It also explains the difficulties which beset this activity, particularly in the areas of data selection and the timing of data collection and dissemination. Uncertain assumptions about energy resources, the level and content of economic activity, and elasticities account for some of the variations in forecast. Two trends in forecasting are apparent: (1) projections of energy consumption, production, and price made in a given time period for a specified future period are often bunched together; and (2) the bunch or set of projections tends to follow recent trends in the variable being projected. 3 figures.

28538 Federal incentives for energy development. Bezdek, R.H.; Cone, B.W. *Energy International;* **5**: 389-406(May 1980).

From 1918 to 1977, the federal government spent $211 billion on incentives to encourage the development of six major conventional energy sources: 1) oil, $101.3 billion (48%), 2) electricity transmission and distribution, $50.5 billion (23.9%), 3) commercial nuclear power, $18 billion (8.5%), 4) natural gas, $16 billion (7.6%), 5) hydropower, $15.3 billion (7.3%), and 6) coal, $9.8 billion (4.6%). These funds were disbursed in six ways: 1) taxation (46.3%), 2) requirements, such as price controls (20.5%), 3) market activities, such as the Tennessee Valley Authority (19.2%), 4) nontraditional government services (9.3%), 5) traditional services (4.2%), and 6) direct payment (0.5%). An analysis indicates that the major reason for these incentives were to promote the development of a new technology and to make up the difference between the value of an activity to the public sector and its value to the private sector.

2940 Fossil Fuels

REFER ALSO TO CITATION(S) 27823, 27836, 27837, 27841, 27842, 27842, 27843, 27843, 27853, 27854, 27855, 27856, 27857, 27858, 27859, 27859, 27860, 27860, 27861, 27861, 27862, 27862, 27863, 27876, 27877, 27878, 27879, 28538

28539 (AD-A—137766/2) U.S. Energy: aviation perspective. Blake, C.L. (Federal Aviation Administration, Washington, DC (USA). Office of Environment and Energy). Nov 1983. 191p. NTIS, PC A09/MF A01.

This report is a sequel/update of The Impact of Petroleum, Synthetic and Cryogenic Fuels on Civil Aviation, DOT/FAA/EM-82/29, June, 1982. Where the earlier report is more concerned with energy resources and availability, this report is more concerned with energy supply/demand balance and with prices. The report reviews world and U.S. energy, U.S. transportation energy, aviation fuel, natural gas, alternative fuels and energy sources, synthetic fuels, aviation fuel conservation, and petroleum price vulnerability. It draws heavily on The National Energy Policy Plan of 1983 and its supporting documents. World oil production and prices should remain generally steady for thirty to fifty years, growing slightly faster than the world economy. Near-term prices should be softer. OPEC can raise prices whenever demand for its production exceeds 80% of OPEC production capacity. The U.S. could delay or reverse future price rises by encouraging, or at least reducing restrictions against, domestic production. All future energy forecasts are risky. A disruption in crude production at any time until at least year 2000, can easily increase fuel prices by 100%.

28540 (ANL/ER-TM—84-1(Vol.1)) Freight network modeling system. Volume 1. Freight network equilibrium model - theory and validation. (Argonne National Lab., IL (USA)). Apr 1984. Contract W-31-109-ENG-38. 115p. NTIS, PC A06/MF A01; GPO Dep. Order Number DE84011806.

The Powerplant and Industrial Fuel Use Act of 1978 empowered the US Department of Energy to prohibit the use of oil and natural gas in powerplants and major fuel-burning installations. The legislation requires that these powerplants convert to coal or seek exemptions. Such regionwide conversions to the use of coal raise the question of whether the existing transportation system possesses sufficient capacity to deal with the expected increase in coal haulage. Whether deleterious impacts will result from the anticipated increased coal haulage can only be determined from a careful analysis of the intermodal freight network. This need motivated the development of the intermodal freight network model described in this report. The application of this freight model to the study of coal transportation impacts resulting from conversions in the Northeast is described in Friesz et al. (1981a), and those resulting from conversions in Florida in Tobin et al. (1983). The purpose of this report is to present the theoretical development of the model and its validation. This work is intended to develop and validate a model of the freight system that is able to: substantially replicate the performance of the freight transportation system by realistically representing the behavior of its principal decision-makers, shippers, and carriers, and how they interact with one another; be applicable to a full range of policy questions by further distinguishing between the behavior of shippers who need to be represented as individuals and those whose identities are merged to form spatially aggregated groups; be easily applied to important planning issues by not requiring data that is neither already available nor readily obtainable; and be repeatedly used to analyze many possible scenarios or solve very large problems by having an efficient solution algorithm that is inexpensive to implement. 61 references, 14 figures, 7 tables.

28541 (DOE/ET/14693—T12) Peat deposits of North Carolina. Summary and final report. Ingram, R.L. (North Carolina Univ., Chapel Hill (USA)). 13 Mar 1984. Contract AC18-79ET14693. 8p. NTIS, PC A02/MF A01; GPO Dep. Order Number DE84007693.

Btu and ash content were analyzed. Peats were classified according to the degree of decomposition as fibric, hemic, or sapric. Locations obtained from soil maps are estimated to cover 90 to 95% of the state's resources. 1 figure, 2 tables. (PSB)

28542 (EPRI-EA—3456-Vol.1) Nonutility demand for coal. Volume 1. Industrial coal demand. Final report. Klein, D.E.; Roach, C.R.; Ebert, C.D. (ICF, Inc., Washington, DC (USA)). Mar 1984. 183p. Electric Power Research Inst., Research Reports Center, P.O. Box 50490, Palo Alto, CA 94303. Order Number DE84920370.

The potential for coal consumption in industrial boilers and non-boiler equipment is examined. Since expectations as to the extent of these demands are likely to change in the future, the analyses develop methodologies and approaches for the reader to evaluate competing coal demands in response to changing conditions. Forecasts are developed to illustrate use of the methodologies, but are not intended to represent absolute predictions of the future. Two methodologies are presented. The Industrial Boiler Fuel Choice Model forecasts fuel demands and fuel choice decisions for new and existing industrial boilers. A companion model, the Process Heat Model (PHM), covers fossil fuel use in non-boiler equipment plus by-product fuel use in both boiler and non-boiler equipment. These two models are useful tools for heating the importance of a great many market uncertainties that affect fuel use in the industrial sector. Such uncertainties include the level of fuel demand as it is affected by economic growth, energy conservation, and the pace of scheduled boiler retirements; costs of different fuels, equipment, and capital; and many different environmental and energy regulations. The methodologies developed in the course of this project have subsequently been incorported into an overall coal market forecast. The integrating tool for this was Coal and Electric Utilities Model (CEUM). Using a coal market model such as CEUM, it is possible to explore further the non-utility demands developed here, evaluating likely coal supply patterns and price effects. 12 figures, 83 tables.

2950 Hydrogen And Synthetic Fuels

REFER ALSO TO CITATION(S) 28519, 28539

28543 (CONF-840702—3) Economics of hydrogen production: the next twenty-five years. Gaines, L.L.; Wolsky, A.M. (Argonne National Lab., IL (USA)). Mar 1984. Contract W-31-109-ENG-38. 12p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE84007279.

From 5. world hydrogen energy conference; Toronto, Canada (15 Jul 1984).

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We project the costs through 2010 of hydrogen produced in the US using four commercially available technologies (electrolysis and three fossil-fuel processes). Our projections are based on estimated capital costs and real energy prices projected by five sources. The sensitivity of hydrogen cost to changes in feedstock costs and the fixed charge rate on capital is examined. The cost is stable against variation in feedstock prices because feedstocks can be changed. The timing of any such change would depend on the capital charge rate. Our results establish cost goals for new technologies attempting to penetrate the market for chemical hydrogen; they also indicate the economic competitiveness of conventionally produced hydrogen in the fuel market. In 2010, hydrogen delivered to customers will be more expensive than methane, its strongest competitor, and any transition to a hydrogen economy in the US will not yet have begun. In nations with higher oil and gas costs or lower electricity costs, such a transition could occur earlier.

28544 (PB—84-164045) Providing R and D (research and development) test fuels from alternate energy sources: an assessment of options. (National Academy of Sciences - National Research Council, Washington, DC (USA)). Sep 1983. 88p. NTIS, PC A05/MF A01.

In the committee's view, the current outlook for short-term stability in the oil market is deceptive because signals in today's surplus oil market do not reflect the underlying medium and long-term trends. The global nature of the current oil supply problem, coupled with the unstable political situation in the Middle East, carries with it an ever-present risk to national security. The Department of Defense (DOD) because of its need for an assured supply of mobility fuels during periods of crisis will probably be a primary market for fuels that would be available from initial synthetic fuel plants

supported by the U.S. Synthetic Fuels Corporation; the DOD also is likely to continue to be the government agency having the largest requirement for test fuels from alternate sources needed to support a broadly-based engine-fuels RandD program. The committee concluded that there is a definite need for a variety of synthetic mobility test fuels to support on-going and planned engine/fuel interaction research and development programs. Provision of adequate supplies of such fuels will require a well-managed and coordinated program supported by a dedicated, highly flexible facility capable of producing such fuels as required on a timely and economical basis. The program should be managed by a single authority within DOD, responsible for coordinating test-fuel requirements of RandD organizations of the military and other government agencies. The program manager should develop plans for production and procurement of RandD synthetic test fuels and arrange for implementation of those plans and be aware of progress in the synfuels industry.

2960 Electric Power

REFER ALSO TO CITATION(S) 28253, 28258, 28505, 28532, 28538, 29315

28545 **(DOE/EIA—0397(83/4Q)) Electric Power Quarterly, October-December 1983.** (USDOE Energy Information Administration, Washington, DC. Office of Coal, Nuclear, Electric and Alternate Fuels). Apr 1984. 329p. NTIS, PC A15/MF A01; 1 - GPO; GPO Dep. Order Number DE84011537.

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The Electric Power Quarterly (EPQ) provides comprehensive information about the electric utilities' cost, quantity, and quality of fossil fuel receipts, net generation, fuel consumption, and fuel stocks on a plant and company level, as well as State, census region, and national aggregates.

28546 **(DOE/NBM—4010757) Small power production interconnection issues and costs. Final report.** Patton, J.B.; Iqbal, S. (Systems Control, Inc., Palo Alto, CA (USA)). 27 Feb 1981. Contract W-31-109-ENG-38. 47p. NTIS MF A01; 2; GPO Dep. Order Number DE84010757.

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Grid-connected small power production facilities pose new economic and technical interconnection problems for the utility and generator owner. This report presents sample interconnection arrangements and component costs for small power producers less than 100 kW. In addition, three California utility interconnection policies are discussed to illustrate utility concerns and the basis for their specific requirements. The interconnection costs for the sample arrangements range from $2000 to $11,000. In general, small power producers requiring synchronizing equipment, distribution primary ground fault detection equipment, and a dedicated distribution transformer incur the greatest interconnection cost. Small, line-dependent (i.e., induction generators, line-commutated inverters) generating devices utilizing modified motor protection require the least expensive interconnection equipment.

28547 **(DOE/RG/10246—T1) Agricultural Load Management Programm. Detailed report .** (California Public Utilities Commission, San Francisco (USA)). 31 Mar 1982. Contract FC01-79RG10246. 307p. NTIS MF A01; 2; GPO Dep. Order Number DE84011280.

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This report presents detailed results of the experimental portion of an agricultural load management program in California (involving the application of time of use rates to customers with demands between 15 to 500 kW) as seen by the California Public Utilities Commission Staff. The work consists of two electric utility experiments: one by the Pacific Gas and Electric Company in which the experimental accounts were randomly selected from a volunteer pool and one by the Southern California Edison Company, in which the experimental accounts were chosen by a random selection process from almost all of its agricultural customer population. (In both cases, however; accounts for equipment which would rarely operate on-peak were excluded from consideration).

28548 **(DOE/RG/10246—T2) Agricultural Load Management Program. Summary report.** (California Public Utilities Commission, San Francisco (USA)). 31 Mar 1982. Contract FC01-79RG10246. 36p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE84011276.

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This report summarizes and interprets the initial results of the experimental portion of an agricultural load management program in California (involving the application of time of use rates to customers with demands between 15 to 500 kW) as seen by the California Public Utilities Commission Staff. The work consists of two electric utility experiments: one by the Pacific Gas and Electric Company in which the experimental accounts were randomly selected from a volunteer pool and one by the Southern California Edison Company, in which the experimental accounts were chosen by a random selection process from almost all of its agricultural customer population. (In both cases, however; accounts for equipment which would rarely operate on-peak were excluded from consideration).

28549 **(EPRI-AP—3420) Development of an EPRI reliability assessment system (ERAS) for combined-cycle power plants.** Brown, H.; Young, R. (Arinc Research Corp., Annapolis, MD (USA)). Mar 1984. 75p. EPRI-Research Reports Center, Box 50490, Palo Alto, CA 94303. Order Number DE84920317.

This report describes the development of a data base for analyzing root causes of failures to equipment used mostly in combined-cycle power plant installations. Microcomputers and commercial data management software were used to develop a data base exchange network that provides rapid data processing and feedback to project participants. Every month, twelve utilities provided plant maintenance records, principally work orders, for processing into raw data files. Data encompassed planned outages, unplanned outages, and noncurtailing maintenance activity. Data were analyzed to identify key areas for reliability, availability, and maintainability improvement.

28550 **(EPRI-EL—2561-Vol.6) Electric Generation Expansion Analysis System. Volume 6. Installation manual. Final report.** Fleck, W.D.; Charny, L. (Stone and Webster Engineering Corp., Boston, MA (USA)). Mar 1984. 56p. EPRI-RRC, Box 50490, Palo Alto, CA 94303. Order Number DE84920372.

EGEAS is a modular state-of-the-art capacity expansion software package. It contains five capacity expansion analysis options ranging from preliminary analysis tools based on screening curves and linear programming to sophisticated nonlinear analysis tools utilizing a Generalized Benders' Decomposition algorithm and a Dynamic Programming algorithm. A stand alone, detailed probabilistic production costing algorithm is also available for prespecified expansion plan production cost and reliability analysis. The multiple EGEAS analysis options are incorporated into a single control analysis program allowing users to match the analysis option selected to a particular problem's requirements and complexity. At the same time, the implementation of a flexible modular and extendable data base common to all five analysis options simplifies data input and maintenance, and rules out input-related inconsistencies among the analysis options. The development and implementation of a detailed but nevertheless efficient probabilistic production costing algorithm made possible the addition to EGEAS of a number of advanced features. These features include maintenance scheduling, economy interchange and reserve sharing, storage and limited energy unit modeling as well as Non-Dispatchable Generation and Load Management analysis. Sensitivity, uncertainty and trade-off analyses are also available in EGEAS. The structure and capabilities of EGEAS as well as the results of a testing and validation effort exercise are presented in Volume 1. Volume 2 includes mathematical appendices and a detailed description of the three generating systems used for testing and validating EGEAS. Volume 3 is the User's Manual, Volume 4 the Programmer's Manual, Volume 5 the Validation Manual, and Volume 6 is the Installation Manual.

28551 **(EPRI-EL—3192) Considerations in designing and using power system operator training simulators. Final report.** Quada, J.J.; Jurkoshek, C.W.; Rosa, D.L.; Anderson, M.D. (Electrocon International, Inc., Ann Arbor, MI (USA); Cleveland Electric Illuminating Co., OH (USA); Missouri Univ., Rolla (USA). Dept. of Electrical Engineering). Apr 1984. 284p. EPRI-RRC, Box 50490, Palo Alto, CA 94303. Order Number DE84920369.

As the complexity of power system operation increases, the need for advanced operator training facilities becomes more critical. An Operator Training Simulator (OTS) that simulates the static and dynamic responses of the power system can increase an operator's knowledge of the behavior of his power system and its response to various controls. RP1915-1, Considerations in Designing and Utilizing System Operator Training Simulators, was undertaken to develop guidelines for an advanced OTS that would satisfy the need to train system operators while also being useful to operations planners, long-range planners, and software and hardware support personnel.

28552 **(EPRI-EL—3425-CCM-Vol.2) Approach for determining transfer capability objectives. Volume 2. Documentation of approach and software. User's manual.** Merrill, H.M.; Bhavaraju, M.P. (Power Technologies, Inc., Schenectady, NY (USA); Public Service Electric and Gas Co., Newark, NJ (USA)). Mar 1984. 135p. EPRI-RRC, Box 50490, Palo Alto, CA 94303. Order Number DE84920362.

Transfer capability, the ability to transmit power from one area to another, is a measure of the strength of a transmission network. As such, adequacy of transfer capability is an important planning consideration. Planners have not had a comprehensive approach for setting transfer capability objectives. The purpose of this project was to assist in satisfying that need. The approach devised recognizes the multiple and conflicting objectives with which a planner must deal. It leads to reasonable transfer capability objectives that take account of the practical options a utility has available and of the uncertainties it faces. The approach was successfully demonstrated on a large, realistic test system, derived from an existing power pool. Computer programs which can be used in applying the approach were developed and tested.

28553 **(EPRI-EL—3437) Utility survey of methods for minimizing the number and severity of system separations. Final report.** Juves, J.A.; Willoughby, R.D.; Batenburg, A. (Westinghouse Electric Corp., Pittsburgh, PA (USA). Advanced Systems Technology Div.). Mar 1984. 119p. EPRI-RRC, Box 50490, Palo Alto, CA 94303. Order Number DE84920371.

Project RP1952-1 was a research project to identify analytical tools and techniques for preventing and recognizing system separation conditions that could lead to cascading outages and widespread blackouts. The project evaluated operating strategies for coping with uncontrollable loss of load, analytical tools currently being used, tools currently under development, and additional research needs applicable to the bulk power system. Data sources included interviews with utilities and power pools, published literature, and information obtained through the North American Electric Reliability Council. The problem of system separation refers to the process of electrical islanding that contributes to an uncontrolled loss of load. Minimizing the effects of system separation means minimizing the spread of the uncontrolled load loss. The objective of this project was to further the understanding of system separation and to identify research needs to prevent its occurrence and minimize its effects. This report contains a summary of information on system separation for use by the power system engineer. Research needs are also presented.

28554 **(INIS-mf—8923) Response of the Government of Ontario to the final report of the Royal Commission on Electric Power Planning.** (Ontario Ministry of Energy, Toronto (Canada)). May 1981. 128p. NTIS (US Sales Only), PC A07/MF A01. Order Number DE84780204.

In March 1980, after nearly five years of hearings and research, the Ontario Royal Commission on Electric Power Planning submitted the first volume of its final report. The remaining eight volumes were submitted in April 1980. The Commission made 88 recommendations on technical, operational, and policy issues. The present document sets out the Ontario government's response to the recommendations. The government accepts and is implementing 77 recommendations. Four recommendations require further study, and six have been rejected.

28555 **(NP—4770270) Compensatory charge as guarantee of power supply.** Voss, A. (Koeln Univ. (Germany, F.R.)). 1981. 146p. (In German). NTIS (US Sales Only), PC A07/MF A01. Order Number DE84770270.

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First, the legal base of the compensatory charge is described, followed by an evaluation of its revenue systematics. Since the compensatory charge revenue does not go into the federal budget, but to a special fund, a budget evaluation follows. In the framework of a financial evaluation, the effects of imposing this charge are investigated. The differences between a political assessment and a financial evaluation of this charge are shown by giving MP statements made. According to the present situation, it is also possible to combine the various purposes of power taxation in an ingeniously contrieved manner under the aspects of finance and psychology. It follows that a power tax might still be levied at a time when the original purpose of its introduction is no longer applicable.

2980 Consumption And Utilization

REFER ALSO TO CITATION(S) 27853, 27855, 27876, 28536, 28599

28556 **(DOE/EIA—0214(82)S) State energy data report supplement: consumption estimates, 1960-1982.** (USDOE Energy Information Administration, Washington, DC. Office of Energy Markets and End Use). May 1984. 92p. NTIS, PC A05/MF A01; 1 - GPO; GPO Dep. Order Number DE84011869.

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This State Energy Data Report Supplement presents selected summaries and percent changes of energy consumption by State, by principal energy source, and by major end-use sector. This report is a supplement to the primary publication, State Energy Data Report, 1960 through 1982, published in May 1984, that provides complete information on sources of data and methods used to calculate the State end-use consumption estimates.

28557 **(NP—4901194) Connecticut energy data.** (Connecticut Office of Policy and Management, Hartford (USA). Energy Div.). May 1984. 72p. NTIS, PC A04/MF A01. Order Number DE84901194.

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This report contains a statistical summary of energy consumption and prices in Connecticut from 1960 to 1983. Data are presented on gross energy consumption, power generation, net energy consumption by fuel type (petroleum, natural gas, electricity, coal), net energy consumption by sector (residential, commercial, industrial, transportation), and energy prices. Connecticut heating degree days from 1970 to 1983 are tabulated. (DMC)

2990 Unconventional Sources And Power Generation

REFER ALSO TO CITATION(S) 28036, 28051, 28062, 28145, 28160, 28517

28558 **(DOE/CE/15095—T1) Technical assistance and information dissemination for the Appropriate Technology Small Grants Program. Final report, May 4, 1982-February 17, 1984.** (National Center for Appropriate Technology, Butte, MT (USA)). 1984. Contract AC01-82CE15095. 200p. NTIS MF A01; 2; GPO Dep. Order Number DE84010957.

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The Final Report is organized according to the four major contract tasks, with a description of the activities associated with each task followed by a summary of achievements against task milestones. These tasks are to: provide technical assistance; obtain, review, and evaluate grantee final reports; screen the information in reports for dissemination; and prepare how-to publications and

other suitable information products. The appendices that follow present several support documents, including a summary of technical assistance clients and the forms used in delivering the service; data collection forms and technology categories used in the report review process; copies of the information materials that were produced; and the mailing list of organizations and agencies participating in the national dissemination program along with support letters and announcements used to coordinate the program with these organizations.

28559 **(DOE/CS/69104—2) Bibliography: jobs, employment and training in energy.** (Michigan Dept. of Commerce, Lansing (USA)). Jul 1983. Contract FG45-80CS69104. 8p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE84008915.

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This bibliography is separated into three categories: Jobs and Energy - the impact of energy development and conservation on the national and regional employment picture; Employment and Energy - identifying and locating specific jobs in energy-related organizations; and Training in Energy - identifying and locating training opportunities in community, junior, and technical colleges along with four-year colleges and universities.

28560 **(DOE/IA/06316—T1) Portugal/United States cooperative energy assessment. Volume I. Azores and Madeira. Part 2 of 2 parts.** (Argonne National Lab., IL (USA)). Sep 1981. Contract AI01-78IA06316;W-31-109-ENG-38. 147p. NTIS, PC A07/MF A01; 1; GPO Dep. Order Number DE84011693.

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This section describes the activities and results of the cooperative energy assessment for the autonomous regional districts of the Azores and Madeira undertaken by the Governments of Portugal and the United States assisted by the Azores district government. This regional assessment forms part of a broader energy assessment conducted for the whole of Portugal, presented in Volume 1, Part 1. Special attention, involving a separate analysis, was given to the Azores and Madeira at the request of the Government of Portugal because of their unique conditions and their physical separation from mainland Portugal. The methodology consisted of 2 phases - data base assembly and integrated analysis. Domestic resources included: biomass small-scale hydropower, geothermal, direct solar, and wind. 48 figures, 81 tables.

30 DIRECT ENERGY CONVERSION

3001 Mhd Generators

28561 **(CONF-840667—3) Major remaining technical issues in coal-fired MHD technology.** Doss, E.D.; Johnson, T.R.; Petrick, M.; Redman, W.C. (Argonne National Lab., IL (USA)). 1984. Contract W-31-109-ENG-38. 26p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE84012099.

From 22. symposium on engineering aspects of MHD; State College, MS, USA (26 Jun 1984).

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A recent assessment of the current status of MHD technology has revealed significant progress in recent years toward establishing the technical base required for commercial coal-fired MHD power plants. The review also identified the many major technical issues that remain. Here attention is directed only to these major areas, to provide perspective regarding the diversity of additional development work required, and to indicate those aspects deserving priority. The underlying assumption is that a systematic development of a sound and broad technical base will be more cost-effective than initially building a large-scale integrated system to acquire operating experience.

28562 **(EPRI-AP—3399) Transient electrical behavior in magnetohydrodynamic generators. Final report.** Koester, J.K.; Eustis, R.H. (Stanford Univ., CA (USA). High Temperature Gasdynamics Lab.). Apr 1984. 271p. EPRI-RRC, Box 50490, Palo Alto, CA 94303. Order Number DE84920323.

Large-scale magnetohydrodynamic (MHD) power generators require electrode controls and power conditioning for efficient, reliable operation. The behavior of generator electrical nonuniformities induced by both internal faults and by external circuits was investigated in this project. A technique for describing nonuniformities was developed by both analytic and experimental methods. An analytic model for the plasma region is described for the effect of general variations in Faraday currents and axial-leakage currents on electrode voltages in terms of nine sets of influence coefficients. The use of these coefficients as a rapid method convenient for studying the characteristics of electrical nonuniformities is described. The development and results of a computer code for predicting the value of influence coefficents as a function of geometry, plasma-boundary layers, and Hall effect are presented. The experimental measurements of these coefficients in a laboratory-scale MHD channel by ac diagnostic equipment are described and compared with theory. The validity of the influence-coefficient approach is demonstrated by experiments. The effects of finite segmentation, nonlinear arc-voltage drop, and plasma coupling on the temporal evolution of electrical nonuniformities are presented. The conditions for buckling-type instabilities of electrode-current distribution are defined. A channel-equivalent circuit based on a lumped-parameter model that can simulate Hall effect, electrode arcs, and plasma coupling is shown. Relationships between lumped parameter values and influence coefficients are presented. 47 references.

3005 Fuel Cells

28563 **(DOE/ET/15440—17) Development of molten carbonate fuel cell power plant technology. Quarterly technical progress report No. 17, October 1 to December 31, 1983.** (United Technologies Corp., South Windsor, CT (USA). Power Systems Div.). Jan 1984. Contract AC02-79ET15440. 29p. NTIS, PC A03/MF A01; GPO Dep. Order Number DE84007231.

Report FCR-6037.

The overall objective of this program is to develop and verify the design of a prototype molten carbonate fuel cell stack which meets the requirements of a 1990's-competitive, coal-fired, electrical utility central station, or industrial cogeneration power plant. Progress is reported.

28564 **(DOE/ET/17019—7) Development of molten carbonate fuel cell power plant. Quarterly technical progress report, August 1, 1981-October 31, 1981.** (General Electric Co., Schenectady, NY (USA). Energy Systems Programs Dept.). 31 Dec 1981. Contract AC02-80ET17019. 98p. NTIS, PC A05/MF A01; 1; GPO Dep. Order Number DE84011243.

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Work proceeded this quarter mainly under three program tasks. Under Task 1.0, cost estimates for the four candidate power plant systems were finalized. Pacific Gas & Electric proposed a number of system modifications to reduce the size, cost and complexity of the fuel cell system. The modifications are being evaluated and will be factored into the final selection of the reference power plant concept. Under Task 2.0, work continued on cell component (anode, cathode, current collector and electrolyte) development and stack design and analysis. Under Task 3.0, the conceptual design of the one-tenth scale stack test facility was completed and cost estimates for the detailed design and construction were prepared. Details are given. (WHK)

28565 **(DOE/ET/17019—8) Development of molten carbonate fuel cell power plant. Quarterly technical progress report, November 1, 1981-January 31, 1982.** Barta, R.W.; Osthoff, R.C.; Reinstrom, R.M.; Harrison, J.W.; Mazandarany, F.N.; Marianowski, L.G. (General Electric Co., Schenectady, NY (USA). Energy Systems Programs Dept.). 26 Feb 1982. Contract AC02-80ET17019. 84p. NTIS, PC A05/MF A01; GPO Dep. Order Number DE84011244.

Work proceeded this quarter mainly under three program tasks. Under Task 1.0, the four candidate power plant configurations were ranked and the Steam Injection System was recommend-

ed as the reference plant design. The Steam Injection System was chosen based on its overall simplicity, high performance level, balance of plant state-of-technology readiness and economic attractiveness. Work was initiated on refinement of fuel cell piping costs. Under Task 2.0, work continued on cell component (anode, cathode, current collector and electrolyte) development and stack design and analysis. Corrosion test results after 1000 hours in fuel gas and 3000 hours in cathode gas are reported for 310SS, 316SS, 446SS, chromium, IN690, and GE2541. In the cathode environment, 310SS and GE2541 show good thermal cycling properties, whereas the other alloys show scale spalling during thermal cycling. Examination of a Ni-clad 316SS anode current collector tested in a cell for 2000 hours shows second phase precipitates along the grain boundaries of the nickel. Experiments with different grades of nickel in an anode atmosphere were started in order to evaluate the effects of impurities present in the metals. Under Task 4.0, work continued on installation of the bench scale single cell test facilities, one atmospheric and one pressurized (up to 10 atm), which will be used in cell testing with contaminants in the fuel and oxidant. (WHK)

28566 **(DOE/ET/17019—10) Development of molten carbonate fuel cell power plant. Quarterly technical progress report, May 1, 1982-July 31, 1982.** Barta, R.W.; Osthoff, R.C.; Reinstrom, R.M.; Harrison, J.W.; Browall, K.W.; Marianowski, L.G. (General Electric Co., Schenectady, NY (USA). Advanced Energy Programs Dept.). 17 Dec 1982. Contract AC02-80ET17019. 131p. NTIS, PC A07/MF A01; 1; GPO Dep. Order Number DE84011241.

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Work proceeded this quarter under three program tasks. Under Task 1.0, work continued on the preparation of the reference power plant design description with Pacific Gas and Electric being one of the major contributors to the effort. Work also continued to further define the power conditioning equipment. Under Task 2.0, work continued on alternate cathode material identification, anode, cathode and electrolyte tile development, and stack design and analysis. A number of candidate cathode materials were fabricated and preliminary conductivity, solubility and stability tests performed. The chemistry of the degradation process of state-of-the-art NiO cathodes was also addressed. Under Task 4.0, studies continued to identify chemical reactions that might occur between fuel cell anode material and a number of organic compounds which could occur in fuel gases. The addition of several substances showed little effect on catalytic activity in a tube furnace or cell performance except for carbon plugging of a fuel line following ethanol addition. In addition, two cells were run this period to determine the effects of H_2S contamination on cell performance. Both tests were terminated (after 480 hours and 1450 hours of testing) due to test equipment operational problems. (WHK)

28567 **(DOE/ET/17019—11) Development of molten carbonate fuel cell power plant. Quarterly technical progress report, August 1, 1982-October 31, 1982.** Barta, R.W.; Osthoff, R.C.; Reinstrom, R.M.; Harrison, J.W.; Browall, K.W.; Marianowski, L.G. (General Electric Co., Schenectady, NY (USA). Advanced Energy Programs Dept.). 24 Feb 1983. Contract AC02-80ET17019. 124p. NTIS, PC A06/MF A01; 1; GPO Dep. Order Number DE84011240.

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Work proceeded this quarter under three program tasks. Under Task 1.0, work was completed on the reference power plant design description. Under Task 2.0, work continued on the development of materials, anode, cathode and electrolyte, and on stack design and analysis. Long term corrosion tests of current collector alloy specimens continued, with 310SS, GE2541 and Aggalloy showing adherent scale formation in the cathode gas atmosphere after 7000 hours. A number of alternate cathode materials were fabricated and tested for conductivity, solubility and stability. A new conductivity measurement device has been partially constructed. Under Task 4.0, testing of the effects of hydrocarbons in the fuel on the operation of carbonate fuel cells was completed. This series of tests has shown that small amounts of organic compounds do not adversely affect fuel cell operation. Testing of a cell with H_2S contamination in the fuel has proceeded for over 1700 hours. Cell performance decreased with increasing concentrations of H_2S, as would be expected, but also recovered substantially when clean fuel gas was introduced for a period of 378 hours. (WHK)

28568 **(PB—84-160969) Fuel cell reactions in super acid electrolytes. Annual report, 1 Jun 82-31 May 83.** O'Grady, W.E. (Associated Universities, Inc., New York (USA)). Nov 1983. 20p. NTIS, PC A02/MF A01.

A series of perfluorosulfonic acids including CF3SO3H, CF2(SO3H)2, (CF2)2(SO3H)2, (CF2)2(SO3H)2 and (CF2)4(SO3H)2 have been examined for fuel cell applications. The reduction of O2 in CF3SO3H, CF2(SO3H)2, and (CF2)3(SO3H)2 is comparable to that achieved in 4M KOH. The (CF2)2(SO3H)2 comes out of solution at elevated temperatures (80C), possibly as the anhydride. The (CF2)4(SO3H)2 material did not give good O2 reduction kinetics, and it is believed this was due to impurities, probably chloride. The behavior of the hydrogen electrode in all of the above acids was quite unique. At higher concentrations (>5N), an unusual shift of the reversible potential was discovered. This shift appears to be related to the lack of water upon which to discharge the hydrogen as a proton, because the effect decreases at lower concentration. The shift may be attributed to the difficulty in putting a proton back onto the extremely strong acid anions formed by the perfluorinated mono and disulfonic acids.

28569 **Steam reforming of fuel to hydrogen in fuel cell.** Young, J.E.; Fraioli, A.V. (to Dept. of Energy). US Patent Application 6-513,523. 13 Jul 1983. 11p. Contract W-31-109-ENG-38.

A fuel cell is described capable of utilizing a hydrocarbon such as methane as fuel and having an internal dual catalyst system within the anode zone, the dual catalyst system including an anode catalyst supporting and in heat conducting relationship with a reforming catalyst with heat for the reforming reaction being supplied by the reaction at the anode catalyst.

32 ENERGY CONSERVATION, CONSUMPTION, AND UTILIZATION

REFER ALSO TO CITATION(S) 28501, 28558

28570 **(AD-A—137918/9) Energy conservation strategies for Army installations. Final report.** Hittle, D.C. (Army Construction Engineering Research Lab., Champaign, IL (USA)). Jan 1984. 33p. (CERL-IR-E—187). NTIS, PC A03/MF A01.

This report summarizes research to identify problems in current energy conservation programs and identify the policies, programs, and research efforts needed to support and improve the effectiveness of these programs. The study described in this report evaluated the energy decision-making and energy management processes at the installation level and in scoped and organized problems associated with effective conservation and cost avoidance. The purpose of this study was to ensure that all problems were identified and organized. Finding solutions is a larger, ongoing and future effort. To achieve the goals of this study, policy documents were reviewed, energy use data was analyzed, site visits were made, and an 'ideal' energy conservation strategy was developed to facilitate problem identification and classification. Major problems were identified, including: the need for more energy use and for procedures to effectively use energy data to control consumption; the need to determine the optimum level of energy-related management and maintenance; the need to collect and share energy conservation project data; and the need to simultaneously consider conservation programs, maintenance and repair, fuel selection, and centralized vs decentralized energy systems.

3201 Buildings

REFER ALSO TO CITATION(S) 28163, 28169, 28534, 28535

28571 **(CONF-8404147—1) Parameters affecting air infiltration and air tightness in thirty-one east Tennessee homes.** Gammage, R.B.; Hawthorne, A.R.; White, D.A. (Oak Ridge National Lab., TN (USA); Tennessee Univ., Knoxville (USA). Dept. of Chemistry). 3 Apr 1984. Contract AC05-84OR21400. 14p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE84011577.

From ASTM symposium on measured air leakage performance of buildings; Philadelphia, PA, USA (2 Apr 1984).

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A major pathway for loss of conditioned air in east Tennessee homes with externally located heating, ventilation, and air-conditioning (HVAC) systems is leakage in the ductwork. The effect on infiltration rates, as measured by Freon-12 tracer gas dilution, becomes marked if the central duct fan is operating; duct-fan on and duct-fan off measurements of the rate of air exchange gave mean values of 0.41 and 0.78 h^{-1}, respectively, in a total of 31 homes. Specific leakage areas measured by the blower-door, pressurization-depressurization technique are affected to a lesser extent by inclusion of the ductwork volume within the total volume of the house that is being pressurized. A subset of 7 of the study homes were measured using this technique; the average increment in the specific leakage area was about 15%. In dealing with homes that have central HVAC systems, weatherization and energy conservation programs should be cognizant of the seriousness of air and energy losses caused by leaking ductwork. 8 references, 2 tables.

28572 **(DOE/CS/10097—1) Analysis of shared savings vs. direct financing of energy retrofits in federal buildings. Final report.** (DHR, Inc., McLean, VA (USA)). May 1984. Contract AC01-81CS10097. 122p. NTIS, PC A06/MF A01; 1; GPO Dep. Order Number DE84012225.

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This study examines the merits of using shared savings contracts with the private sector to foster energy conservation retrofits in federally-owned buildings. Shared savings is a generic term used to refer to a contractual arrangement between a building owner and a private organization which specializes in energy retrofits. For the purposes of this analysis, the Federal Government and a shared savings company enter into an agreement wherein the company makes capital improvements and/or operating changes to improve the energy efficiency of a federally owned facility at no out-of-pocket cost to the government. The resulting savings in reduced (or less rapidly increasing) energy bills are shared by the two parties according to a predetermined formula for a finite period of time. This study sought to evaluate from the Federal Government's perspective the desirability of shared savings as compared with direct federal financing, under which the Federal Government uses conventional financing methods to undertake the same retrofits. Both options were compared with the status quo, in which retrofits are financed and performed by individual agencies, but where financial resources are lacking to undertake a comprehensive retrofit program on the scale made possible by shared savings. Using a simple cash flow model, shared savings and direct federal financing approaches were each applied to the retrofit of three hypothetical federally owned structures: a hospital, commissary, and a large office building. Federal Government (or agency) cash in-flows and out-flows were calculated for each scenario, and the net cost or savings to the Federal Government estimated. In addition to the quantitative analysis, interviews with members of the energy retrofit contracting industry and government officials were conducted.

28573 **(DOE/CS/22014—T1) Local initiatives in building energy conservation: the role of local government and current activities in eleven cities.** (US Conference of Mayors, Washington, DC). Sep 1981. Contract FG01-80CS22014. 69p. NTIS, PC A04/MF A01; 1; GPO Dep. Order Number DE84011207.

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Local government efforts to conserve energy in buildings range from city-sponsored energy audits to large-scale, coordinated energy management planning. This report reviews current activities, the extent of interest shown in building energy conservation and the various roles cities have found appropriate to reduce building energy consumption. Background information on the U.S. building energy conservation movement is presented, followed by an introductory section discussing the intent and scope of the report and the methods used to gather data. Chapter one is a brief narrative of the current roles city governments are adopting in support of building energy conservation. Chapter two, Summaries of Current City Activities, presents the findings of the city survey. Activities are summarized for each city, and are also classified in a matrix of the type of activities found in each city. General trends and study conclusions are discussed in the final chapter of the report.

28574 **(DOE/CS/23936—T5) Certification/enforcement: preliminary analysis and recommendations.** (Vitro Labs., Silver Spring, MD (USA)). 13 May 1981. Contract AC01-81CS23936. 63p. NTIS, PC A04/MF A01; GPO Dep. Order Number DE84010944.

This report provides preliminary analysis and recommendations with respect to five major issue areas: manufacturer reporting and data retention requirements, the use of industry testing programs, sampling plans, treatment of small business, and economic analysis of certification/enforcement requirements. The C/E approach reflected here represents a low level of DOE intervention in consumer product markets. This approach, which is essentially the minimal intervention approach described in the preamble to the Notice of Proposed Rulemaking (NOPR), bears marked similarities to the current enforcement approach of the FTC labeling program. (The FTC approach received substantial industry support in comments to the NOPR.) The approach relies heavily on information received from manufacturers in their certification of product compliance and from voluntary industry association testing programs.

28575 **(DOE/CS/23936—T6) Certification/enforcement implementation procedures.** (Vitro Labs., Silver Spring, MD (USA)). 30 Sep 1981. Contract AC01-81CS23936. 69p. NTIS, PC A06/MF A01; GPO Dep. Order Number DE84010945.

The regulations in this subpart prescribe the procedures to be followed for certification and enforcement testing to determine whether a basic model of a covered product complies with the applicable energy efficiency standard. Included in appendices are: a sampling plan for enforcement testing, required information and format for the manufacturer certification reports, required information and format for private labeler certification reports, and suggested information to be retained by the manufacturer on energy efficiency test facilities and instrumentation.

28576 **(DOE/CS/23936—T7) Certification/enforcement issues: analysis and recommendations.** (Vitro Labs., Silver Spring, MD (USA)). 30 Sep 1981. Contract AC01-81CS23936. 82p. NTIS, PC A05/MF A01; GPO Dep. Order Number DE84010940.

This report provides preliminary analysis and recommendations with respect to five major issues areas: manufacturer reporting and data retention requirements, the use of industry testing programs, sampling plans, treatment of small business, and economic analysis of certification/enforcement requirements. These recommendations embody a change in the overall certification/enforcement approach that DOE has chosen to implement after reviewing comments to the Notice of Proposed Rulemaking (NOPR). The C/E approach reflected here represents a low level of DOE intervention in consumer product markets. This approach is essentially the minimal intervention approach described in the preamble to the NOPR and bears marked similarities to the current enforcement approach of the FTC labeling program. The FTC approach received substantial industry support in comments to the NOPR. The approach relies heavily on information received from manufacturers in their certification of product compliance and on the effectiveness of voluntary industry association testing programs.

28577 **(DOE/CS/23936—T8) Certification/enforcement: docket analysis. Final report.** (Vitro Labs., Silver Spring, MD (USA)). 30 Sep 1981. Contract AC01-81CS23936. 94p. NTIS, PC A05/MF A01; GPO Dep. Order Number DE84010941.

The following subjects are covered: the DOE certification/enforcement (C/E) approach, sampling plan, use of industry program, reporting requirements, retention of test units, recertification requirements, timing of C/E requirements, administrative appeal, penalties for noncompliance, test variability, availability of test facilities, small business, import/export products, cost of C/E program, right-of entry, government/industry coordinating committee, manufacturer quality control requirements, enforcement testing, and field testing. (MHR)

28578 **(DOE/CS/23936—T9) Summary of certification/enforcement procedures and supporting analysis.** (Vitro Labs., Silver Spring, MD (USA)). 30 Sep 1981. Contract AC01-81CS23936. 35p. NTIS, PC A03/MF A01; GPO Dep. Order Number DE84012125.

In response to concerns expressed in written and oral comments to the NOPR, DOE has made several important changes to the certification/enforcement (C/E) portion of the rule. The C/E approach currently being proposed represents a substantially lower level of DOE intervention in consumer product markets and bears marked similarities to the current enforcement approach of the FTC energy efficiency labeling program. The revised approach places primary emphasis on the reliability of information received from manufacturers in their certification of product compliance and on data received from the voluntary industry association testing programs. A summary of the certification/enforcement portion of the revised proposed rule is presented. Key changes that have been made in the certification/enforcement portion of the proposed rule from that presented in the original NOPR are analyzed.

28579 **(DOE/ID/12018—10) Groundwater heat pumps in Colorado: an efficient and cost-effective way to heat and cool your home. Special publication 18.** Garing, K.L.; Connor, F.R. (Coury and Associates, Lakewood, CO (USA)). 1981. Contract FC07-79ID12018. 36p. NTIS, PC A03/MF A01; GPO Dep. Order Number DE84012499.

This pamphlet discusses the advantages and disadvantages of owning and operating a groundwater heat pump. The mechanism for operation of a heat pump is presented first. Information is then provided which allows potential users to estimate the size of the heat pump required for individual needs. Given this information and the economic analysis presented later in this pamphlet, a potential user can decide for himself whether the groundwater heat pump is a practical and worthwhile investment for his specific application.

28580 **(DOE/OR/21400—T9) Southwest thermal mass study. The effect of envelope thermal mass on the heating energy use of eight test buildings in a high desert climate. Research phase I, September 1981 through December 1982.** Gustinis, J.; Robertson, D.K. (New Mexico Univ., Albuquerque (USA). New Mexico Energy Research and Development Inst.). Apr 1984. Contract AC05-84OR21400. 114p. NTIS, PC A06/MF A01; 1; GPO Dep. Order Number DE84011214.

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Eight windowless one-room test buildings, 6.10 m square and 2.29 m high inside, were constructed on a high desert site near Tesuque Pueblo, New Mexico, to study the influence of wall dynamic heat transfer characteristics on building heating energy requirements (such influence is sometimes called the "thermal mass effect"). The buildings are nominally identical except for the walls, and are instrumented to record building component temperatures and heat fluxes; indoor temperature, humidity, globe temperature, and interior surface temperatures; and outdoor weather, solar data, and ground temperatures. This report presents the results from analysis of heating season data for one year. A simple method of analysis using steady-state methods on time-averaged data is derived from first principles. Energy use data for each building are correlated to weather parameters and building interior conditions, and are compared to predictions of steady-state modeling. Comfort parameters are evaluated for each building, and critically compared. In situ measurements of wall thermal properties and dynamic heat transfer characteristics are presented, including data for adobe walls.

28581 **(DOE/R1/10850—1) Engineering, analytical, and program management assistance to the US Department of Energy Boston Support Office. Final report.** Jones, W.; Azad, B.; Poston, P. (B and M Technological Services, Inc., Boston, MA (USA)). Aug 1982. Contract AC02-81R110850. 42p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE84011541.

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The scope of the monitoring effort included a total of 132 grants awarded to schools, hospitals, and other eligible institutions throughout the six New England States. The monitoring was conducted during a six-month period at the rate of approximately 22 grantees per month. Table 1 presents a summary of grantees assigned for monitoring for the period December 1981 - May 1982. The nature of the monitoring involved a significant level of communication and coordination with State Program Coordinators at the Boston Support Office and Program Managers at the State Energy Offices. The monitoring required the cooperation and active participation of the grantees' energy conservation grant project managers and building operators. The effort also required a high level of internal coordination due to the geographic dispersion of the grantees being monitored and the need to maintain regular communication with federal- and state-level officials during the course of the project. To address the requirements of all parties involved in the monitoring, it was necessary to organize and conduct the work in a systematic fashion. As a result, the approach to the monitoring program consisted of five distinct steps which were replicated on a monthly basis for each group of grants assigned for monitoring. These steps included: scheduling of site visits; review of working files prior to each visit; site visitation and meeting with grantee officials; notification of BSO regarding critical problems; and preparation of site visit and monthly reports.

28582 **(DOE/R6/12054—T1) High efficiency heat pump using ground heat source. Final report.** Reeves, C.R. (Reeves (C. Richard), Austin, TX (USA)). Dec 1983. Contract FG46-80R612054. 26p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE84006385.

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The purpose of this project was to demonstrate a high efficiency ground coupled heat pump for residential use. The most important aspect of the demonstration was the method of ground coupling for the heat pump. The system used a water well and closed loop heat exchanger for ground coupling in a method that is practical and may be widely applied in the central Texas area. The heat pump system was installed in a typical family residence in Austin, Texas, and used as the only means of heating and cooling for one year. System performance was monitored and operating data were recorded and compared with predictions made during the design phase of this project. A summary of the project and a list of conclusions concerning the performance and practicality of the heat pump system demonstrated are presented. The design of the system and predictions made for its performance are discussed. The measured performance of the demonstration system is discussed. A cost comparison of the demonstration system and a more conventional heat pump system is included. Cost figures for the demonstration system are presented there.

28583 **(DOE/SF/11510—T3) Study of the external wind pressure distributions and induced internal ventilation flow in low-rise industrial and domestic structures.** Vickery, B.J.; Baddour, R.E.; Karakatsanis, C.A. (Western Ontario Univ., London (Canada). Boundary Layer Wind Tunnel Lab.). Jan 1983. Contract AC03-80SF11510. 352p. NTIS, PC A16/MF A01; 1; GPO Dep. Order Number DE83015607.

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The study reported consists of three major phases: comparison of computed and measured internal flows, preparation of a data base for external pressures on low-rise buildings, and the develop-

ment of design aids. Test procedures are described in detail, and the measured and computed flow comparisons are discussed. The origins of the data base, the methods employed in the reformulation and the results obtained are presented and discussed. Some sample design charts are presented. (LEW)

28584 **(EPRI-EA—3442-Vol.1) Energy and household expenditure patterns. Volume 1. Residential energy demand. Final report.** Lareau, T.J.; Darmstadter, J. (Resources for the Future, Inc., Washington, DC (USA)). Mar 1984. 178p. EPRI-RRC, Box 50490, Palo Alto, CA 94303. Order Number DE84920351.

This study analyzes and projects long-term trends in the pattern of US household expenditures and examines the energy-consumption implications of those trends. A time-series analysis of household expenditures relies both on dynamic and systems formulations, and is supplemented by cross-sectional findings from consumer budget studies as well as by policy and technological considerations. The energy requirements of a projected household bill of goods were determined by the adaptation of results from a companion input-output study. Although personal consumption expenditures - in constant-dollar terms - are projected at a bit over a 2-1/2 percent average annual growth rate to the year 2000, the associated direct and indirect energy requirements are estimated to rise by only 0.6 percent yearly. This significant slowdown in energy growth stems from the effect of both the changing composition of personal consumption expenditures as well as falling energy-per-dollar coefficients for a wide range of expenditure categories. The preponderant share - about two-thirds - of US primary energy consumption is attributable to the direct and indirect demands of consumers. Thus, the findings of this study suggest the likelihood of a significant slowdown in growth of the nation's overall energy consumption.

28585 **(NP—4770271) Operational efficiency of heating systems in the residential sphere.** Broetzenberger, H. (Bundesministerium fuer Handel, Gewerbe und Industrie, Vienna (Austria)). Mar 1977. 149p. (In German). NTIS (US Sales Only), PC A07/MF A01. Order Number DE84770271.

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28586 **(NP—4901090) Options for energy efficiency in the residential sector: 1983-2000. Illinois Energy Plan, Volume 8.** (Illinois Dept. of Energy and Natural Resources, Springfield (USA)). Jun 1983. 250p. NTIS, PC A11/MF A01. Order Number DE84901090.

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This report is a state-wide analysis of energy efficiency options that would provide least-cost energy services in the five largest areas of residential energy service demand. The goal of this analysis was to determine the levels of efficiency required in appliances, equipment and building shells to provide the least costly delivery of energy services for refrigeration, foodfreezing, air conditioning, water heating, and the level of comfort maintained by furnaces, existing building shells and new residential construction. The net potential energy and dollar savings, the value of individual and total reductions in energy consumption minus the investment required to produce the increased efficiency, is identified for each residential service demand over the study period - 1983 through the year 2000. In addition to the least-cost analysis and the projections of direct and indirect economic impact on the economy as a whole, this report also proposes the elucidation and development of several criteria and methodologies which would approach two goals: (1) utility conservation investment programs should pursue the implementation of all economically feasible, cost-effective energy conservation measures in the residential sector through maximum participation of residential customers, and (2) utility conservation investment programs should result in a fair and equitable distribution of program costs and benefits among participating and non-participating ratepayers.

28587 **(ORNL/CON—104) Residential conservation service: model audit manual multifamily audit procedure.** McLain, H.A.; Bircher, T.; MacDonald, J.M.; Ohr, S.Y. (Oak Ridge National Lab., TN (USA)). Apr 1984. Contract AC05-84OR21400. 126p. NTIS, PC E07/MF $5.75; 1; GPO Dep. Order Number DE84011857.

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A Residential Conservation Services (RCS) multifamily audit procedure was developed for dwelling units located in buildings having more than four such units. The RCS multifamily audit is designed to satisfy the RCS rule amendments, which expand the RCS program to include energy audits for dwelling units in buildings having more than four units, which are neither centrally heated nor cooled. The RCS multifamily audit is basically a modification of the RCS Model Audit manual for single-family housing. Major modifications made in the single-family audit procedure for application to multifamily dwelling units are: (1) new procedure for estimating infiltration rates in multifamily buildings, (2) new buffer space correction factors for unit dwellings, and (3) a new procedure for estimating the heat gain due to solar radiation through the windows. The RCS multifamily audit is designed to be completed in about 2-1/2 hours for most dwelling units. The computational procedure is designed to be simple and relatively quick, and does not require the use of a computer. Included in the RCS multifamily audit are: (1) audit procedure, (2) audit forms, (3) audit methodology, (4) sample audit questionnaire, and (5) supplemental data base/calculation aids.

28588 **(PB—84-153907) Gas-fired heat pump research and development: review and assessment. Final report, Sep 81-Feb 83.** Kinast, J.A.; Wurm, J. (Institute of Gas Technology, Chicago, IL (USA)). Dec 1983. 194p. NTIS, PC A09/MF A01.

Three categories of systems were identified. The first category is of systems that are well understood, but require further refinement to develop a feasible air conditioner or heat pump. This category includes internal combustion engine-based systems, Stirling-based (and similar) systems, and adsorption and absorption systems. Some systems in this category currently under study were also considered promising during past research because of their high practical potential. Current technology could solve or reduce the technical problems encountered in past research. The other systems in this category did not appear promising in the past, but have been developed to the extent that further consideration is once again warranted. The second category includes systems that are well understood but have reached established thermodynamic limits. Ejector systems are in this category. The third category consists of systems that show promise, but need further knowledge of fundamental operating principles to be developed. Magnetic and thermoelectric systems are in this category. Our findings also show that successful production and marketing requires the fully committed participation of researchers, manufacturers, and gas utilities. This assessment is supplemented by a bibliography and list of projects for the period between 1954 and 1972.

28589 **(PB—84-154004) Calibration of temperature measurement systems installed in buildings. Building science series (final).** Hurley, C.W.; Schooley, J.F. (National Bureau of Standards, Washington, DC (USA). Center for Building Technology). Jan 1984. 87p. (NBS-BSS—153). NTIS, PC A05/MF A01.

Energy Management Control Systems (EMCS) cannot function properly or efficiently without accurate temperature measurements since temperature is one of the fundamental measurements of any EMCS. This report was written for the purpose of describing various methods of on-site calibration of temperature sensing devices used in EMCS and to review the characteristics of these devices that are directly related to calibration. The significance of recording the results of each calibration is emphasized and the possible effects of systematic errors in temperature monitoring systems is discussed.

28590 **(PB—84-156157) Demonstration of remedial techniques against radon in houses on Florida phosphate lands. Final report.** Scott, A.G.; Findlay, W.O. (American Atcon, Inc., Columbia, MD). Jul 1983. 195p. NTIS, PC A09/MF A01.

This report is to document the results of an activity which forms part of a program intended to demonstrate means of controlling indoor radon levels in structures built on Florida phosphate lands. The natural radon content of the soil is elevated in some parts of the Florida phosphate lands, resulting in elevated radon concentrations in the soil gas. If building construction is such as to provide pathways, or routes of entry, between the interior of the building and the soil below, then this radon-bearing soil gas may enter the building and result in elevated indoor levels. This report therefore documents a review of current building practices, with the intention of identifying routes of entry. Based upon this knowledge, certain modifications to building practices may be seen as a means of reducing indoor radon levels.

28591 **(PB—84-163625) Washer with electrolytic water dissociation. Final report.** Morello, M. (Commission of the European Communities, Luxembourg). 1984. 32p. (EUR—8483-EN). NTIS, PC E03/MF E03.

The development of a washing machine with turbo-electrolytic pre-wash facility is described. This process involves a preliminary electro-chemical process which is characterized by an overall reduction in energy consumption during the wash cycle. Comparative studies between the turbo-electrolytic washing machine and a standard washing machine have been carried out. Although the production cost of the turbo-electrolytic machine is greater, savings on energy costs will give rise to a net reduction in costs over the lifetime of the machine.

28592 **(PNL-SA—12221) Small office building handbook: Design for reducing first costs and utility costs.** Holton, J.K.; Swanson, T.D.; Gulati, R.; Hart, G.K. (Burt, Hill, Kosar, Rittlemann, and Associates, Butler, PA (USA)). 31 Mar 1984. Contract AC06-76RL01830. 333p. NTIS, PC A15/MF A01; 1; GPO Dep. Order Number DE84011491.

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A summary of key findings from this project is presented. A detailed sample problem illustrated precisely how this handbook is used to select cost effective energy saving strategies. A complete decision-making process is provided for selecting energy saving strategies in five climates covering the continental US. Detailed descriptive materials explain this process. An alternative design process is provided for use in situations where the more simplified selector is not appropriate. (MHR)

28593 **(TVA/OP/ECR—84/24) TVA home insulation program energy saving.** Hagood, A.T.; Cooper, P.G. (Tennessee Valley Authority, Chattanooga (USA). Div. of Energy Conservation and Rates). Jan 1984. 14p. NTIS, PC A02/MF A01. Order Number DE84901137.

This study examined the energy saving from the home weatherization program for participants who weatherized their houses from December 1978 through February 1981 using a TVA loan. Based on a preweatherization/postweatherization analysis using participants' utility bills, the estimated reduction in electrical consumption after installing weatherization measures with a TVA loan was 3,219 kWh per heating season with a standard error of 953 kWh and 212 kWh per cooling season with a standard error of 558 kWh.

28594 **(UVA—527240/SEAS84/102) Development of Schladitz fuel injection for commercial oil burners using residual fuel oils.** Schladitz, H.J.; Wawner, F.E. (Virginia Univ., Charlottesville (USA). School of Engineering and Applied Science). Nov 1983. Contract AC05-79ER10066. 73p. NTIS, PC A04/MF A01; 1; GPO Dep. Order Number DE84011500.

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To produce a very fine droplet-size in a fuel burning system is desirable because the increased surface area facilitates vaporization and hence cleaner and more efficient combustion. In fact, if the oil droplet size is sufficiently small, efficiency is such that the fuel will burn with a blue flame (much like natural gas) and with minimal smoke, soot, and other pollutants. This has been demonstrated using Schladitz Fuel Injectors (SFI) in residential oil burners. Based on this, the present study was initiated with the objective to duplicate this phenomenon in commercial oil burners (less than 30 gallons per hour) utilizing residual fuels (Nos. 4, 5, and 6) with emphasis on No. 6. The results are presented.

28595 **Durable-good choice: a benefit-cost approach applied to air conditioning.** Krumm, R.J. (Univ. of Chicago, IL). *Resources and Energy;* **5**: No. 4, 369-401(Dec 1983).

A model of the household air conditioning adoption decision is developed which is based on the comparison of benefits and costs of alternative system choices. Based on this conceptual analysis, a discrete choice empirical model is estimated which distinguishes between adoption of room units and central air conditioning systems. The results indicate that factors influencing the structure of household benefits and system costs importantly affect the adoption decision in a systematic manner. 8 references, 6 figures, 5 tables.

28596 **The cost of conserved energy as an investment statistic.** Meier, A. (Environment Div., Lawrence Berkeley Laboratory, University of California, Berkeley, CA). *Helvetica Physica Acta;* **55**: No. 9, 73-77(Sep 1983).

With the rapid rise in energy prices, energy conservation has become an integral part of many firms' operations. However, conservation investments must compete with other ventures for capital and attention. The conservation investments frequently lose. This is, in part, due to a misunderstanding of energy conservation. Most conservation measures improve efficiency and do not require any sacrifice or reduced service. They improve the efficiency of combustion, heat transfer, or heat recovery. In buildings, typical measures include more efficient motors and lights and more carefully sized and balanced ventilation systems. Even after this initial confusion, a more serious question arises: How should we assess investments in energy efficiency? This article presents a new investment statistic to provide more realistic consideration of conservation opportunities. The CCE is a more compact statement of the costs directly associated with a conservation measure and not cluttered with the excess baggage of energy price assumptions. The cost of conserved energy with its extension, the supply curve, is a convenient technique of expressing the economics of energy conservation. The supply curves establish a framework for considering the potential for conservation. The CCE recognizes that the goal is providing specific services, not energy itself, and that more efficient energy use may achieve those services more economically.

28597 **Design guidelines on lateral airflow through and around buildings.** Bowen, A. (School of Environmental Design College of Engineering King Abdulaziz University, Jeddah). pp 517-533 of Passive and low energy architecture. Yannas, S.; Bowen, A. Oxford, England; Pergamon Press (1983). (CONF-830630—).

From International conference on passive and low energy architecture; Chania, Crete, Greece (27 Jun 1983).

A mass of sketches are available, in professional literature, on air movement through building interiors and around groups of buildings. Much of this information is misleading, as it is frequently based on the limited knowledge and expansive imagination of designers, who have not thoroughly researched this topic. This paper records airflow patterns established in reliable laboratory experiments and field studies and identifies their original sources. It is intended to assist architects, builders and designers of the urban environment.

28598 **A predictive air infiltration model - Field validation and sensitivity analysis.** Sherman, M.H.; Grimsrud, D.T.; Modera, M.P. pp 6.A.1-6.A.10 of Energy conservation in the built environment. Minogue, P. Dublin, Ireland; An Foras Forbartha (1982). (CONF-8210216—). Contract W-7405-ENG-48.

From 3. international symposium on energy conservation in the built environment; Dublin, Ireland (1 Oct 1982).

In this paper, we report on a comparative study of residential infiltration as predicted by our computer model and as measured in our Mobile Infiltration Test Unit (MITU) as well as in selected test houses, both occupied and unoccupied. Sensitivity analyses were also conducted on each parameter contained in the model against data obtained from MITU. The predictive model, which projects infiltration rates based on selected building and site parameters and local weather conditions, and the MITU, a portable test structure designed to continuously monitor air infiltration, local weather, and indoor-outdoor pressure differences, are fully described. From these field validation and sensitivity tests, we determined that the most critical parameters for accurate prediction of infiltration in residences in terms of accuracy of prediction are the leakage area of the building shell and the degree to which the structure is shielded from the wind.

28599 **A simplified method for calculating heating and cooling energy in residential buildings.** Sonderegger, R.C.; Garnier, J.Y. (Lawrence Berkeley Laboratory, Univ. of California Berkeley, CA). pp 2.140-2.153 of Energy conservation in the built environment. Minogue, P. Dublin, Ireland; An Foras Forbartha (1982). (CONF-8210216—). Contract W-7405-ENG-48.

From 3. international symposium on energy conservation in the built environment; Dublin, Ireland (1 Oct 1982).

We have recently developed a microcomputer-based program, "Computerized, Instrumented, Residential Audit" (CIRA), for determining economically optimal mixes of energy-saving measures in existing residential buildings. This program requires extensive calculation of heating and cooling energy consumptions. In this paper, we present a simplified method of calculation that satisfies the requirements of speed and memory imposed by the type of microcomputer on which CIRA runs. The method is based on monthly calculations of degree-days and degree-nights for both heating and cooling seasons. The base temperatures used in calculating the degree-days and degree-nights are derived from thermostat settings, solar and internal gains, sky radiation losses and the thermal characteristics of the building envelope. Thermostat setbacks are handled by using the concept of effective thermal mass of the house. Performance variations of HVAC equipment with changes of part load and ambient conditions are taken into account using correlation curves based on experimental data. Degree-days and -nights for different base temperatures are evaluated by using a climate-specific empirical correlation with monthly average daily and nightly temperatures. Predictions obtained by this method and by DOE-2.1 are compared for the so-called Hastings ranch house for seven different climates in the United States. Heating and cooling energy consumptions predicted by CIRA lie generally within + or - 10% of DOE-2.1 predictions.

28600 **Glazing optimization for energy efficiency in commercial office buildings.** Johnson, R.; Selkowitz, S.; Winkelmann, F.; Zentner, M. (Lawrence Berkeley Laboratory, Berkeley, California). pp 3.40-3.50 of Energy conservation in the environment. Minogue, P. Dublin, Ireland; An Foras Forbartha (1982). (CONF-8210216—).

From 3. international symposium on energy conservation in the built environment; Dublin, Ireland (1 Oct 1982).

A principal component of annual energy consumption in a building is attributable to energy transfers in the fenestration system. Annual energy requirements are not only a function of glazing properties, but also of other building design characteristics, operating characteristics, site conditions, and climate. This paper describes results of a study in which annual energy consumption with and without daylighting utilization in a office building module was modeled parametrically for a wide range of glazing properties in three different climates. We present results which suggest optimal combinations of glazing properties which frequently result in lower energy consumption than opaque insulated walls.

28601 **A mobile facility for measuring net energy performance of windows and skylights.** Klems, J.H.; Horwitz, S.; Selkowitz, S. (Lawrence Berkeley Laboratory, University of California, Berkeley, California). pp 3.1-3.12 of Energy conservation in the built environment. Minogue, P. Dublin, Ireland; An Foras Forbartha (1982). (CONF-8210216—).

From 3. international symposium on energy conservation in the built environment; Dublin, Ireland (1 Oct 1982).

A Mobile Window Thermal Test (MoWiTT) Facility is being built at Lawrence Berkeley Laboratory in order to use direct measurement to verify predictions of the net energy performance of fenestration systems and other complex elements of the building envelope. It consists of one or more wheeled modules together with an instrumentation van. Each module contains two room-sized (2.4m x 3.1m x 2.4m) guarded calorimeters, each capable of accurately measuring the net energy flow through a sample under all conditions of solar gain. Expected performance of the facility is calculated using the program BLAST. We conclude that it provides a much more accurate measuring capability than the passive cell commonly in use.

28602 **Evaluation of current guidelines of good practice for condensation control in insulated building envelopes.** Achenbach, P.R.; Techsel, H.R. pp 1090-1107 of Proceedings of the ASHREA/DOE Conference Thermal Performance of the Exteria Envelopes of Buildings II. Atlanta, GA; A.S.H.R.A.E. (1982). (CONF-821217—).

From ASHRAE/DOE conference on thermal performance of building envelopes; Las Vegas, NV, USA (5 Dec 1982).

Moisture problems in building envelopes can develop from six different sources of moisture; namely, use of wet materials in construction, capillary rise of ground moisture, leakage of rainwater or melted snow, condensation of water vapor, persistent high humidity conditions, and leakage of piped water. This paper is concerned with condensation caused by dew point temperatures occurring on or within building envelope constructions, and closely related phenomena. Condensation in building envelopes can be either a summer or winter phenomenon, although winter condensation has been given much greater attention in building standards and guidelines in the United States. Current standards and guidelines seek to control condensation by proper use of vapor retarders. Various criteria for the winter use of vapor retarders in building envelopes are based almost entirely on outdoor dry-bulb temperature and are not entirely consistent. However, a task group assembled to prepare recommendations for the Department of Energy on moisture control in retrofitted houses determined that house size, occupant density, air infiltration rate, type of heating system, and quality of workmanship affect the potential for winter condensation, in addition to outdoor temperature. The potential for summer condensation in building envelopes is confined principally to humid climates and fringe locations near the Gulf of Mexico and South Atlantic coasts of the United States, and to tropical or subtropical island locations. Summer condensation is limited to air-conditioned buildings, for the most part, although mold and mildew can develop without condensation when high humidities occur in buildings. Not all types of air-conditioning systems are effective in controlling relative humidity in humid climates.

28603 **The Kieper and MOISTWALL moisture analysis methods for walls.** Tenwolde, A. (Forest Products Laboratory, Forest Service, U.S. Department of Agriculture). pp 1032-1051 of Proceedings of the ASHREA/DOE Conference Thermal Performance of the Exteria Envelopes of Buildings II. Atlanta, GA; A.S.H.R.A.E. (1982). (CONF-821217—).

From ASHRAE/DOE conference on thermal performance of building envelopes; Las Vegas, NV, USA (5 Dec 1982).

Few methods are available to predict water vapor migration through walls and to assess the potential for condensation. The moisture profile method, described in the ASHRAE Handbook -- 1981 Fundamentals, is the most widely accepted. In 1976 the Kieper method was introduced as an alternative. It attracted relatively little attention, however, and has remained practically unknown. This paper describes the Kieper method in detail and discusses its advantages and limitations. The major advantage is the relative ease of determining the most likely location for condensation in a wall and comparing the performance of different wall designs under identical environmental conditions. The Kieper method is graphical and, like the moisture profile method, based on one-dimensional steady-state vapor diffusion theory. The MOISTWALL program is an adaptation by the author of the Kieper method for a programmable calculator. Neither the original moisture profile

method nor the methods presented in this paper account for the effects of air leakage, hygroscopicity, and capillary action. Moreover, reliable input data for permeability of building materials are often not available. The methods do not provide a direct prediction of moisture damage, because damage also depends on initial moisture content, the types of material involved, temperatures, and the duration of condensation. Despite these limitations, analysis with the Kieper or MOISTWALL methods can provide valuable qualitative insights into the moisture performance of wall assemblies.

28604 **Indoor moisture: effects on structure, comfort, energy consumption, and health.** Kelly, K.M. (Jay-K Independent Lumber Corporation, New Hartford, New York). pp 1007-1032 of Proceedings of the ASREA/DOE Conference Thermal Performance of the Exteria Envelopes of Buildings II. Atlanta, GA; A.S.H.R.A.E. (1982). (CONF-821217—).

From ASHRAE/DOE conference on thermal performance of building envelopes; Las Vegas, NV, USA (5 Dec 1982).

This paper describes the origins of moisture. It shows how to produce, reduce, control, direct, and eliminate moisture in a building. The dynamics of moisture are outlined as related to the use of building materials and design. This paper gives detailed solutions for the cure and prevention of moisture problems, while realizing possible energy savings. The intent of this work is to improve the quality of life, - not only the life of a building, but also its occupants and owners. For the most part, this paper is a compilation of basic scientific facts joined with scientific findings presented over the years regarding housing, health, humidity, etc., and 30 years of personal experience in solving problems in the field.

28605 **A field thermal measurements technique for roof-deck systems.** Orlandi R.D.; Derderian, G.D.; Shu, L.S.; Siadat, B. (Construction Products Division, W. R. Grace & Co., Cambridge, MA). pp 703-719 of Proceedings of the ASREA/DOE Conference Thermal Performance of the Exteria Envelopes of Buildings II. Orlandi, R.D.; Siadat, B. Atlanta, GA; A.S.H.R.A.E. (1982). (CONF-821217—).

From ASHRAE/DOE conference on thermal performance of building envelopes; Las Vegas, NV, USA (5 Dec 1982).

A procedure for field thermal measurement of building envelope systems using heat flow meters (HFM) is presented. HFM are first calibrated in the field at the measurement site using a field HFM calibrator (hereafter referred to as GFHC (1)). After calibration, the CFHC is removed and the calibrated HFM are attached to the building substrate at the measurement site for data acquisition. The location of the HFM during the data acquisition phase is identical to their location during the calibration phase. The HFM output is converted to a heat flux as a function of time by appropriate application of the HFM calibration curve. The underlying principles of the design and construction of the CFHC are provided. The convection and radiation factors that are specific to the particular environment in which measurements are carried out and which affect the HFM calibration are defined and derived from heat transfer theory supported by some experimental data, which are discussed in detail. During HFM calibration, heat fluxes in the range of 2 to 8 Btu/ft^2.hr (6 to 25 W/m^2) are steadily generated and measured for calibration at field conditions. A portable data-logging system capable of scanning 100 channels of information is used for data acquisition at variable scan rates. A computer performs all subsequent data reduction and reporting. The principles of operation of the GFHC are applicable to HFM calibration on nearly any substrate in most field environments.

28606 **Thermal flux measurements with a compensated heat flow meter.** Cvetkovic, M. pp 749-766 of Proceedings of the ASREA/DOE Conference Thermal Performance of the Exteria Envelopes of Buildings II. Atlanta, GA; A.S.H.R.A.E. (1982). (CONF-821217—).

From ASHRAE/DOE conference on thermal performance of building envelopes; Las Vegas, NV, USA (5 Dec 1982).

Measurements with heat flow meters are used to check the thermal protection of buildings or installations in situ as a nondestructive testing method. Putting the heat flow meter on the partition that is measured disturbs the measured thermal flux passing through this partition. The thermal resistance of the heat flow meter affects the partition like a heat source or heat sink. The heat flow meter's surface is smaller than that of the partition and this nonlinear heat flow produces a systematical error in thermal-flux measurement. This error can be eliminated with a new kind of heat flow meter described here. This heat flow meter compensates for this disturbance of temperature field through the partition with one auxiliary source (or sink) of heat. So the measurement becomes one null method, faster and more precise than the former more common method. The heat flow meter can be smaller and can function without a guard ring. Several experiments are made and some of the results are presented.

28607 **Use of large-area heat-flow meters to measure building heat flows.** Klems, J.H. pp 734-748 of Proceedings of the ASREA/DOE Conference Thermal Performance of the Exteria Envelopes of Buildings II. Atlanta, GA; A.S.H.R.A.E. (1982). (CONF-821217—). Contract AC03-76SF00098.

From ASHRAE/DOE conference on thermal performance of building envelopes; Las Vegas, NV, USA (5 Dec 1982).

The problem of measuring area-averaged heat flows in room-sized spaces in the presence of solar radiation is discussed in the context of a room-sized calorimeter facility (MoWiTT). Development of a new type of heat-flow sensor suitable for making such measurements is described, and test results for moderate-sized prototypes 1 ft (0.3 m) square are reviewed. Construction of full-sized units--up to 2 ft X 4 ft (1.2 m X 0.6 m)--is described, and problems encountered during development are discussed. It is concluded that this approach represents a viable method for determining net energy balances in rooms.

28608 **Effects of infrared radiation barriers on the effective thermal resistance of building envelopes.** Falrey, P.W. (Florida Solar Energy Center, Cape Canaveral, FL). pp 859-875 of Proceedings of the ASREA/DOE Conference Thermal Performance of the Exteria Envelopes of Buildings II. Atlanta, GA; A.S.H.R.A.E. (1982). (CONF-821217—).

From ASHRAE/DOE conference on thermal performance of building envelopes; Las Vegas, NV, USA (5 Dec 1982).

A series of tests and measurements have been conducted to determine the potential effectiveness of infrared radiation barriers (aluminum foil) as heat-flow retarders in building envelopes. Both small-scale hot-box tests and full-scale building tests have been employed. Full-scale testing has been conducted under controlled conditions at the Florida Solar Energy Center's Passive Cooling Laboratory (PCL) and in occupied field residences in Orlando, Florida. To date, the work has been concerned only with overheated summer conditions. Plans call for continuation of this testing at the PCL under winter heating conditions. This paper addresses the test methods and results and presents a preliminary analysis of the effectiveness of foil radiation barriers used in building envelopes.

28609 **Dynamic modeling for microprocessor thermal control of buildings using identification techniques.** Cali, M.; Fracastoro, G.; Greco, C.; Marchis, V.; Masoero, M. (Politecnico di Torino, Corso Duca degli Abruzzi 24, 10129 Torino). pp 848-856 of Proceedings of the ASREA/DOE Conference Thermal Performance of the Exteria Envelopes of Buildings II. Atlanta, GA; A.S.H.R.A.E. (1982). (CONF-821217—).

From ASHRAE/DOE conference on thermal performance of building envelopes; Las Vegas, NV, USA (5 Dec 1982).

Knowledge of the dynamic thermal response of buildings is needed in HVAC control applications. The input and output physical quantities involved in the energy budget of a building can be related either using a physical model or using the black-box approach. Following the latter approach, the building is identified as a system with a given number of outputs (e.g., the energy demand for heating, the internal temperature, etc.) and inputs (e.g., the meteorological data, the occupancy pattern, etc.) related by simple linear equations. The calculation of the black-box parameters from sampled experimental input-output data is called identification of the system. This type of approach is particularly well suited for on-line control of the HVAC system, where a physical description would be heavy in terms of number of equations and unreliable due to uncertainties in the physical parameters of the building. Data measured in a highly-instrumented room, part of an existing office

building, have been used to test identification methods that can be implemented on a microcomputer. Results of the analysis are presented and discussed.

28610 **Determination of thermal simulation performance with a reduced-scale structure.** Modera, M.P. (Lawrence Berkeley Laboratory, Berkeley, CA). pp 813-827 of Proceedings of the ASREA/DOE Conference Thermal Performance of the Exteria Envelopes of Buildings II. Atlanta, GA; A.S.H.R.A.E. (1982). (CONF-821217—).

From ASHRAE/DOE conference on thermal performance of building envelopes; Las Vegas, NV, USA (5 Dec 1982).

The University of Liege has constructed a reduced-scale building model for use in determining and improving the accuracy of thermal simulation techniques. The model was designed to provide a high-precision data set that includes globe temperature, air temperature, internal and external surface temperatures, and laboratory and field climatological data. This report describes the construction and instrumentation of the model and the results of tests performed in the laboratory, including comparison with a finite-difference simulation of the dynamic tests. Both the static and dynamic thermal characteristics of the model have been measured in the University of Liege wind-tunnel test chamber. The static heat losses were found to be very close to those determined by hand calculation, 5.44 to 5.54 Btu/hr°F (2.87-2.92 W/°C) in the laboratory, versus 5.42 Btu/hr°F (2.86 W/°C) by hand calculation. For the dynamic tests in the laboratory, as well as for the finite difference simulation of these tests, a two-timeconstant fit was performed. For the response to a step increase in heat input, the laboratory measurements yielded time constants of 6.6 and 0.6 hours and the simulation predicted time constants of 5.9 and 0.8 hours. The laboratory tests also provide insight into the importance certain heat-transfer phenomena will have in the field, such as the directional dependence of the external heat transfer coefficient and its effect on the thermal balance of the model.

28611 **Review of gas-filled window technology summary report.** Sabatiuk, P. (Mueller Associates Inc., Consulting Engineers, Baltimore, MD). pp 643-653 of Proceedings of the ASREA/DOE Conference Thermal Performance of the Exteria Envelopes of Buildings II. Atlanta, GA; A.S.H.R.A.E. (1982). (CONF-821217—).

From ASHRAE/DOE conference on thermal performance of building envelopes; Las Vegas, NV, USA (5 Dec 1982).

A survey of the state of the art of sealed insulating glass units filled with nonair gas mixtures (gas-filled windows) was conducted. The physical principles, potential performance, and technical problems associated with gas-filled windows were investigated, and commercially available windows of this type were identified. Compared to air, certain gases and gas mixtures reduce the conductive and convective heat transfer across the space between window glazings (the interspace). This improvement in thermal resistance is especially significant when the radiative heat transfer across the interspace is reduced through the use of low emissivity films or coatings. The combination of gas filling and low emissivity films or coatings has produced double-glazed windows with U values of as low as 0.17 Btu/h X ft² X °F (0.96 W/m² X °C). In Europe, several types of gas-filled windows are commercially available, and they are sold in large quantities. The most common fill gases used in Europe are argon and sulfur hexafluoride. The commercially available windows have U values of as low as 0.23 Btu/h X ft² X °F (1.3 W/m² x °C). In the United States, however, only two gas-filled windows are available and they are sold in small quantities. The U values of these windows are no lower than those of conventional double-glazed windows. The main reason for this difference in markets is the relatively high cost of energy in Europe, which has stimulated such advanced energy-conserving practices.

28612 **Thermal window louver system reduces heating and cooling loads and uses excess solar energy and building waste heat.** Meckler, G. (Haines Lundberg Waehler, New York, NY). pp 628-642 of Proceedings of the ASREA/DOE Conference Thermal Performance of the Exteria Envelopes of Buildings II. Atlanta, GA; A.S.H.R.A.E. (1982). (CONF-821217—).

From ASHRAE/DOE conference on thermal performance of building envelopes; Las Vegas, NV, USA (5 Dec 1982).

A thermal window louver system that circulates nonrefrigerated water has been tested in both the laboratory and actual applications. This system acts as a dynamic interior solar collector and intercepts 88% of the radiant solar heat before it enters the occupied space, becoming a load on the air-conditioning system. The design combines thermodynamic and systems-integration concepts to maintain environmental stability and comfort while significantly reducing energy consumption, refrigerated air, fan horsepower, and the size of ductwork and equipment. In the summer, when envelope temperature exceeds interior temperature, non-refrigerated louver-water absorbs and carries away 60% of the radiant energy, while 28% is reflected back through the window and 12% enters the space. In a design application, this achieves a 52% savings in the total central plant refrigeration load and a 40% savings in total air distribution. In winter the temperature of the louver water is maintained by building waste heat to offset envelope heat losses and maintain perimeter thermal balance. In exposures with high wintertime solar intensity, the louvers eliminate the need to design for simultaneous heating and cooling. The system eases the capacity problems of utilities by significantly shaving summer peak refrigeration requirements.

28613 **Solar heat gain through single glass-blind fenestrations.** Van Dyck, R.L.; Konen, T.R. (Stevens Inst. of Technology, Hoboken, NJ). pp 589-596 of Proceedings of the ASREA/DOE Conference Thermal Performance of the Exteria Envelopes of Buildings II. Atlanta, GA; A.S.H.R.A.E. (1982). (CONF-821217—).

From ASHRAE/DOE conference on thermal performance of building envelopes; Las Vegas, NV, USA (5 Dec 1982).

Energy-saving venetian blinds have recently been studied using a unique environmental chamber complete with artificial sun. Data from this study have enabled further confirmation of a reported methodology for calculating the shading coefficient for glass-blind systems. This methodology allows architects and engineers to use published data on solar optical propperties of both vertical and horizontal blinds, such as that given in the ASHRAE Handbook 1981 Fundamentals. At present, the guide does not provide a procedure for calculating the shading coefficient for complex window systems using data on solar optical properties. Values of shading coefficient are provided for only a few selected special glazings and "light" and "medium" colored interior blinds. Now, energy-saving blinds with a wider range of shading coefficients have been tested and their performance shown to be consistent with the recommended design procedure. Use of the method and data permits more convenient calculation of solar heat gain in buildings by extending confidence in shading coefficients.

28614 **New models for analyzing the thermal and daylighting performance of fenestration.** Selkowitz, S.E.; Winkeimann, F.C. (Lawrence Berkeley Lab., Univ. of California, Berkeley, CA). pp 597-616 of Proceedings of the ASREA/DOE Conference Thermal Performance of the Exteria Envelopes of Buildings II. Atlanta, GA; A.S.H.R.A.E. (1982). (CONF-821217—). Contract AC03-76SF00098.

From ASHRAE/DOE conference on thermal performance of building envelopes; Las Vegas, NV, USA (5 Dec 1982).

Accurate determination of the energy impact of fenestration in nonresidential buildings requires daylighting prediction as well as thermal modeling. Despite the computational power of hourby-hour simulation programs, they involve trade-offs in accuracy, cost, and flexibility. This paper describes new daylighting and thermal modeling capabilities in DOE-2.1B and planned additions. DOE-2.1B now contains a preprocessor-based daylighting model that is sensitive to daylight availability, site conditions, room and glazing parameters, window management for glare and solar control, and lighting controls. To model more complex designs, the next version of the DOE-2.1 program will have a daylighting model based on stored or user-input coefficients of utilization. A lighting program, named SUPERLITE, provides detailed data on illuminance and luminance distribution throughout interior spaces. Because the solar gains through sophisticated daylighting designs are not now adequately calculated, a procedure based on a library of new heat-gain coefficients is being developed. Using sun and sky simulators, these coefficients will be determined from direct measurements of solar

optical properties of architectural devices. The major experimental procedures and analytical models, along with validation studies of DOE-2.1B and SUPERLITE and sample results from these new modeling tools, are described.

28615 **Impact of building envelopes on energy consumption and energy design guidelines.** Boonyatikarn, S. (College of Architecture and Urban Planning, The University of Michigan, Ann Arbor, Michigan). pp 469-480 of Proceedings of the ASREA/DOE Conference Thermal Performance of the Exteria Envelopes of Buildings II. Atlanta, GA; A.S.H.R.A.E. (1982). (CONF-821217—).

From ASHRAE/DOE conference on thermal performance of building envelopes; Las Vegas, NV, USA (5 Dec 1982).

Energy consumption varies greatly from building to building and from year to year. However, variations in energy consumption caused by a building's exterior envelope may be or may not be significant, depending on the behavior of other energy-related components in the building. Understanding these energy-related factors may be achieved by comparing data from a diverse set of buildings. Toward this end, historical data of more than 50 existing institutional buildings were statistically analyzed in detail. The purpose was to explore major factors that create the most significant energy consumption variations among buildings. A regression model for energy prediction, utilizing these factors, was constructed. The analysis indicated that the contribution to energy consumption variation of exterior envelopes is much less than that of other factors. This finding implies that, for this set of buildings, the reduction of energy consumption through envelope improvement, relative to other factors, is not as significant as might be expected. Thus other, more influential factors should be analyzed carefully. Standards and guidelines for energy conservation should also emphasize these factors.

28616 **Air flow windows: Performance and applications.** Brandle, K.; Boehm, R.F. (College of Architecture and Urban Planning, The University of Michigan). pp 361-379 of Proceedings of the ASREA/DOE Conference Thermal Performance of the Exteria Envelopes of Buildings II. Atlanta, GA; A.S.H.R.A.E. (1982). (CONF-821217—).

From ASHRAE/DOE conference on thermal performance of building envelopes; Las Vegas, NV, USA (5 Dec 1982).

Air flow window units are a combination of energy-efficient fenestration and adjustable shading device. They typically consist of a double-glazed outer sash and a single-glazed inner sash, with venetian or louvered blinds in between. Space air is admitted to the window cavity through a gap at the inner sash and may flow upward or downward. The air is then either exhausted through the outer window frame or returned via duct headers to the central air-handling equipment. Energy savings and improvements of comfort conditions can be achieved from either of the air flow window types. The correct choice, however, requires a careful evaluation of window performance characteristics, local climate conditions, and space heating/cooling levels. Important parameters are, for example, the cavity air flow rate, the amount of exhaust air versus recycled air, the facade orientation, and the magnitude of heat gains in the space. Both windows were tested simultaneously using a conventional double-glazed reference window. The window components and the test data are described, and results from yearly energy modeling are shown. Examples of air flow window installations in Europe and their operational characteristics are also discussed.

28617 **Repeatability and accuracy of pressurization testing.** Persily, A. (Center for Building Technology, National Bureau of Standards, Washington, DC). pp 380-390 of Proceedings of the ASREA/DOE Conference Thermal Performance of the Exteria Envelopes of Buildings II. Atlanta, GA; A.S.H.R.A.E. (1982). (CONF-821217—). Contract AC02-77CS20062.

From ASHRAE/DOE conference on thermal performance of building envelopes; Las Vegas, NV, USA (5 Dec 1982).

Pressurization testing is used to evaluate the airtightness of building envelopes. To experimentally determine the repeatability of pressurization test results, a home was pressure tested about eighty times in one year. The effect of weather conditions on the test results was studied, along with changes in the results over time. For local wind speeds less than 5.5 mph (2.5 m/s), the 0.2 in H_2O (50 Pa) leakage rate has a standard deviation of about 2% of the mean over short time periods. For stronger winds, errors as large as 15% compared to the calm weather test results occured. A seasonal variation in the leakiness of the house, on the order of 25%, was also found. This variation is due to changes in the moisture content of the building materials caused by yearly variation in the moisture content of the outside air.

28618 **Numerical optimization of building subsystems with extreme and design weather conditions.** Kim, R.H. (College of Eng., The Univ. of North Carolina at Charlotte, Charlotte, NC). pp 234-248 of Proceedings of the ASREA/DOE conference Thermal Performance of the Exteria Envelopes of Buildings II. Atlanta, GA; A.S.H.R.A.E. (1982). (CONF-821217—).

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Building systems consist of several subsystems -- roof, wall, windows, doors, etc. Optimum thickness of insulation for these subsystems differs according to the energy gain or loss from or to outside conditions such as radiation (direct and diffuse) of different orientations, dry-bulb and wet-bulb temperatures, and wind directions and their magnitudes. These variables change continuously. Twenty-five-year weather data were used to select the most extreme weather conditions. The Newton-Raphson method is used to determine an optimum insulation thickness for a roof system under ASHRAE design conditions and extreme local conditions. The optimum thickness computed is based on the life-cycle cost approach. The results of the design weather conditions and the extreme local conditions are compared.

28619 **Equivalent annualized cost evaluation for energy-efficient building component evaluation.** Bouchillon, C.W. (Dept. of Mechanical Eng., Mississippi State Univ., MS). pp 221-233 of Proceedings of the ASREA/DOE Conference Thermal Performance of the Exteria Envelopes of Buildings II. Atlanta, GA; A.S.H.R.A.E. (1982). (CONF-821217—).

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The use of levelized annual payment calculated by life-cycle cost analysis has been used in a project study that includes a variety of design choices. The advantage of this method is in the evaluation by the owner of both the initial costing--which relates to initial financing possibilities--and the levelized annual payment--which relates to economic optimization--for the activity. A case study is presented.

28620 **Surface heat transfer in building components.** Fracastoro, G.; Call, M.; Masoero, M. (Dipartimento di Energetica, Politecnico di Torino, Torino). pp 180-203 of Proceedings of the ASHREA/DOE Conference Thermal Performance of the Exteria Envelopes of Buildings II. Atlanta, GA; A.S.H.R.A.E. (1982). (CONF-821217—).

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Design surface heat transfer coefficients that take into account both convection and radiation are customarily used in the calculation of the heat flow transmitted through building components. This simplified approach may lead to incorrect results, particularly when low thermal resistance components such as windows are concerned, and when long-term energy flow calculations, rather than peak load calculations, are performed. The rigorous approach, on the contrary, consists of solving the energy balance at the surface of a component taking into account the appropriate boundary conditions. In this article, radiative and convective heat losses at the outside and inside surfaces are calculated as a function of known meteorological factors and of the temperature and geometry of the internal and external surroundings. The overall energy balance of the component is written and solved numerically. A parametric analysis is performed in order to assess the influence of various building parameters and outdoor conditions on heat transmission through single glazings. Energy calculations for a typical northern Italian location are also presented.

28621 Thermal resistance of reflective insulations installed in a simulated wall cavity. Yarbrough, D.W.; Kim, S.G. pp 204-217 of Proceedings of the ASREA/DOE Conference Thermal Performance of the Exteria Envelopes of Buildings II. Atlanta, GA; A.S.H.R.A.E. (1982). (CONF-821217—).

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The thermal resistances of two types of reflective foil insulation have been measured in an apparatus simulating a wall cavity. The apparatus consisted of a stainless steel screen supported vertically between two water-cooled copper plates. Test materials were installed in the regions between the screen and the copper plates. R-values were determined from the direct current required to maintain a steady-state temperature difference across the test cavities. Results of the study show that the R-values of the foil insulations in wall cavities decreased 20 to 40% as the temperature difference across the wall was increased from 10°F to 50°F (6°C to 28°C). The measured R-values for a three-foil insulation were higher than the R-values for a two-foil product, but both were below the R-values measured on a mineral-fiber batt. R-values for a wall system were calculated from the experimental data.

28622 Dynamic thermal performance of walls and ceilings/attics. Wilkes, K.E. (Owens-Corning Fiberglass Corp., Granville, OH). pp 131-159 of Proceedings of the ASREA/DOE Conference Thermal Performance of the Exteria Envelopes of Buildings II. Atlanta, GA; A.S.H.R.A.E. (1982). (CONF-821217—).

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The Energy Performance Design System (EPDS) provides a simplified method for predicting annual heating and cooling energy consumption in buildings. This system includes the significant contribution from walls and ceilings. The dynamic thermal performance of walls and ceilings has been studied both by theoretical analyses and by laboratory measurements. The paper gives an overview of laboratory measurement capabilities in this area, consisting of a calibrated hot box for walls and a Thermal Research Facility for measurements on horizontal building elements. An overview is also given of measurement programs that have been performed, including extensions to reduce errors resulting from flanking heat flows. Parallel efforts to improve and validate available analytical models for thermal behavior of walls and ceiling/attic systems are described. These efforts involved comparisons of model predictions with predictions from detailed thermal calculations and results from the measurement programs. Certain of these improvements were incorporated into the analytical models; others continue to be studied. These models were then combined with a balance-point accounting procedure and were used to calculate heating and cooling loads for a wide variety of walls and ceiling/attic configurations that are included in EPDS. Calculated results for various orientations were consolidated and represented algebraically as functions of thermal resistance and heating and cooling degree-days with various base temperatures.

28623 Calibrated hot box tests of thermal performance of concrete walls. Van Geem, M.G.; Fiorato, A.E.; Musser, D.W. (Construction Technology Laboratories, Division of the Portland Cement Assoc., Skokie, IL). pp 108-130 of Proceedings of the ASREA/DOE Conference Thermal Performance of the Exteria Envelopes of Buildings II. Atlanta, GA; A.S.H.R.A.E. (1982). (CONF-821217—).

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The object of research described in this paper was to evaluate and compare thermal performance of selected concrete walls. Walls were subjected to steady-state, transient, and periodically varying temperature conditions in a calibrated hot box. Steady-state tests were used to define heat transmission coefficients. Data obtained during periodic temperature variations were used to define dynamic thermal response of the walls. Normal-weight, structural lightweight, and low density concretes were tested. These concretes had unit weights ranging from approximately 50 to 145 pcf. Thermal conductivity of the concretes derived from calibrated hot box tests, ranged from approximately 1.5 to 12.0 Btu.in./hr.ft^2.°F. Conductivities derived from calibrated hot box tests were compared with results from guarded hot plate and hot wire tests. Hot wire tests were also usedto evaluate the influence of moisture on thermal conductivity. Data obtained from dynamic tests were compared with steady-state calculations. In addition, data were compared with calculations of dynamic response made using measured values of thermal properties.

28624 Development and application of a merged solar and meteorological data base. McKay, D.C. (Canadian Climate Centre, Ontario). pp 50-63 of Proceedings of the ASHREA/DOE Conference Thermal Performance of the Exteria Envelopes of Buildings II. Atlanta, GA; A.S.H.R.A.E. (1982). (CONF-821217—).

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Any evaluation of new building designs requires climate data as input. In most instances, the information required is not available at the site in question. To increase the amount of climatic data available for application purposes, work on the definition and development of a merged solar and meteorological data base was initiated and an archive was established. Results from this archive, covering a number of sites across Canada, can now be provided in raw form on magnetic tape or as hard-copy summaries. How the merged data base was established will be discussed and examples will be presented to indicate how the data base is ideally suited to support activities in the building design field.

28625 Effect of relative placement of thermal mass and insulation on building energy use. Rhein, C.F.; Howell, R.H.; Sauer, H.J. (General Motors Proving Ground, Milford, Michigan). pp 95-107 of Proceedings of the ASHREA/DOE Conference Thermal Performance of the Exteria Envelopes of Buildings II. Atlanta, GA; A.S.H.R.A.E. (1982). (CONF-821217—).

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The purpose of this investigation was to determine how mass and insulation interact in building walls and roofs and what effect the relative placement of mass and insulation has on heat losses and gains through the structure. Consideration was given to three wall configurations: Two-layer wall: concrete and insulation and reverse; Three-layer wall: alternating layers of concrete and insulation; Four-layer wall: alternating layers of concrete and insulation. Outdoor temperatures and solar flux rates were altered to determine their effects. Results show that three-layer walls with mass between two layers of insulation are more energy efficient than two- or four-layer constructions. Two-layer walls performed better with insulation on the outside, as was the case with four-layer construction. Altering the relative placement of mass and insulation was found to have a greater effect on cooling loads and energy requirements than on heating needs.

28626 Correlation/prediction of wall heat flow: Computer models versus field data. McGrew, D.P. (DPM Energy Research Corp. Englewood, CO). pp 325-342 of Proceedings of the ASREA/DOE Conference Thermal Performance of the Exteria Envelopes of Buildings II. Atlanta, GA; A.S.H.R.A.E. (1982). (CONF-821217—).

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Recent field testing of 12 wall types in five climates from 1400 to 12,000 degree-days (°F) is analyzed using a proprietary transient-heat-flow program. Acceptably matched models are used to predict seasonal and annual heat flow through various wall types. Two papers presented at the first ASHRAE-DOE Conference on the Thermal Performance of the Exterior Envelopes of Buildings described a method of making field measurements of wall (and other component) heat flows using thermopyle heat flowmeters (HFMs) and a finite-difference modeling technique for simulating wall and window heat flow. This paper reports on the latest large-scale wall study incorporating the two techniques. Field measurements were made on a total of 12 wall types: three frame, four clay masonry, three concrete panel (with and without insulation), one concrete masonry, and one solid timber. Most of the walls were tested in the West Coast cities of Los Angeles, Portland, and Seattle. The timber walls were tested in Edmonton and

Regina, Canada. Wall sections were tested in special test cells and in actual buildings. One-dimensional transient models were used as the primary modeling tool, and the paper contains numeric and graphic "matches" of heat flow and surface temperatures for each wall type. For comparison, other techniques are shown, including ASHRAE response factors. Errors in all methods are discussed Various strategies for long-term seasonal and annual usage predictions are discussed and predictions and their sensitivity analyses are presented. Although whole-building analysis and simulation are valuable, much remains to be learned about individual component behavior.

28627 **Field observations of moisture and organism damage in insulated houses.** Spray, R.A.; Hedden, F.M. (Agricultural Engineering Department, Clemson University, Clemson, SC). pp 1108-1119 of Proceedings of the ASHREA/DOE Conference Thermal Performance of the Exteria Envelopes of Buildings II. Atlanta, GA; A.S.H.R.A.E. (1982). (CONF-821217—).

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Moisture management in houses is discussed as the primary means for controlling biodeterioration in wood structural members. Six houses in South Carolina with various stages of fungi attack are presented. Exterior moisture management techniques such as drains, grading, crawlspace covers and gutters are discussed. Controls for interior moisture management are discussed. These include attic and crawlspace ventilation, vapor retarders and moisture generation. This paper is not a report of research but one of field observation made of moisture problems which develop in houses that lack adequate external and internal moisture management practices.

28628 **A study of moisture migration and accumulation in residential stud walls.** Luft, F.J. (Research & Development Division, Owens-Corning Fiberglas, Corporation, Technical Center, Granville, Ohio). pp 1078-1089 of Proceedings of the ASHREA/DOE Conference Thermal Performance of the Exteria Envelopes of Buildings II. Atlanta, GA; A.S.H.R.A.E. (1982). (CONF-821217—).

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With the increased levels of infiltration control and insulation in low energy houses such as those designed to the targets in the Energy Performance Design System (EPDS) manual, concern has arisen regarding the increased potential for moisture accumulation in building walls. This issue has been addressed with several long-term environmental exposure tests being conducted on stud wall sections which incorporate the construction details being recommended by EPDS. In these tests, instrumented wall panels were installed in a research facility where panel exteriors were exposed to the environment and panel interiors were in contact with interior conditions of controlled temperature and humidity. For each test the accumulation of moisture in the panels was recorded throughout one heating season in Granville, OH, a moderately cold location which averages 5600 heating degree-days annually. Interior temperature was maintained at 72°F in all cases and interior relative humidities of 30% and 50% were examined. Presented is a description of this moisture study and a discussion of its results.

28629 **Field experiences underscore the importance of moisture control in energy-efficient homes.** Jennings, C.W.; Moody, T.L. pp 1063-1077 of Proceedings of the ASHREA/DOE Conference Thermal Performance of the Exteria Envelopes of Buildings II. Atlanta, GA; A.S.H.R.A.E. (1982). (CONF-821217—).

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Tennessee Valley Authority's (TVA) most successful energy conservation project to date is the Home Insulation Program (HIP) which was initiated in August 1977. TVA's HIP is this nation's largest home weatherization effort; it provides free home energy audits and no-interest financing for weatherization measures. Homeowners, tenants, and landlords are eligible for participation through one of TVA's 160 power distributors. As of April 16, 1982, 589,737 living units had been surveyed and 288,820 of these units had approximately $277,000,000. Early in 1980, TVA's central office began receiving complaints from field offices that some weatherized homes were experiencing problems associated with either excessive or insufficient moisture. An investigation was initiated to evaluate and categorize those types of problems and recommend changes to procedures or field actions as required. To date, findings indicate that there are no intrinsic characteristics of the energy-efficient house that cause a moisture problem. Field surveys of houses with complaints have underscored the need for better control of moisture as the infiltration/ exfiltration rates are reduced through weatherization. The solutions to the problems encountered have generally been straightforward provided the moisture source can be readily identified. This paper will review the state-of-the-art for moisture control, provide relevant field experiences, and recommend areas for further research and field study regarding the current construction practices and building codes in use.

28630 **A method for optimization of south window areas in houses.** Barakat, S.A.; Sander, D.M. (Division of Building Research, National Research Council Canada, Ottawa, Ontario). pp 993-1003 of Proceedings of the ASHREA/DOE Conference Thermal Performance of the Exteria Envelopes of Buildings II. Atlanta, GA; ASHRAE (1982). (CONF-821217—).

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A simple graphical procedure is presented for calculating the heating energy requirement of direct-gain, passive solar houses during the design process in order to establish the combination of south window area and thermal storage mass that will minimize purchased space heating energy. It is applicable to the complete range of house construction types, from high-mass, direct-gain passive solar houses to low-mass, light-frame houses. An example illustrates the use of the method in establishing the optimum south-facing window area.

28631 **Economical high R-value brick walls for housing.** Szoke, S.S. (Brick Inst. of America, McLean, VA). pp 971-992 of Proceedings of the ASHREA/DOE Conference Thermal Performance of the Exteria Envelopes of Buildings II. Atlanta, GA; ASHRAE (1982). (CONF-821217—).

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In some instances, high R-values are desirable for residential wall constructions, but the means of achieving a high R-value in exterior wall construction is often costly. One method of obtaining a high R-value with a brick veneer wall system for low-rise residential construction is discussed in this paper, and information is provided regarding its thermal performance, design considerations, and construction procedures.

28632 **Thermal performance of the Blouin superinsulated house.** Hagan, D.A.; Jones, R.F. (Architectural and Building Systems Division, Brookhaven National Laboratory, Upton, NY). pp 949-970 of Proceedings of the ASREA/DOE Conference Thermal Performance of the Exteria Envelopes of Buildings II. Atlanta, GA; ASHREA (1982). (CONF-821217—). Contract AC02-76CH00016.

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An evaluation of the design and thermal performance of a superinsulated residence in South Royalton, VT, is made. Data were acquired by a Solar Energy Research Institute (SERI) Class B monitoring system during 60 days of March, April, and May of 1982. In addition, air infiltration is measured using the fan pressurization technique, and effectiveness of the air-to-air heat exchanger is analyzed. The house design is a copy of the colonial "saltbox". Included are R-40 (RSI-7.2) walls, R-57 (RSI-10.0) ceiling, R-25 (RSI-4.5) pressure-treated wood basement walls, R-9 (RSI-1.5) sliding window shutters, a caulked polyethylene vapor barrier, and a site-built air-to-air heat exchanger. Reported on are the data acquired and an analysis of the thermal performance based on these results. Several possible modifications to the building design are suggested. It is concluded that the measured building thermal parameters are within acceptable error bounds of the calculated values.

28633 Energy monitoring results of a superinsulated passive solar building. McCulley, M.T.; O'Meara, R.; Pederson, C.O. (U.S. Army Construction Res. Laboratory, Champaign, IL). pp 928-948 of Proceedings of the ASHREA/DOE Conference Thermal Performance of the Exteria Envelopes of Buildings II. Atlanta, GA; ASHRAE (1982). (CONF-821217—).

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This paper presents results of an investigation of the thermal performance of a superinsulated passive solar house which is heavily equipped with instruments. Three test days were chosen to measure the building thermal losses under specific controlled conditions. The test periods were conducted during cold nights following cold cloudy days. Infiltration was measured. Calibrated heating units were used to maintain a constant temperature in the house during the test periods. The house was operated in three configurations: (1) a base case, in which the windows were uncovered and the furnace was not used, (2) a period in which the furnace fan was run continuously to measure duct losses, and (3) a period in which the windows were covered with insulating panels. The base case building loss rate was .137 Btu (hr ft^{2}F) (.779 W/(m^{2} X K)). With the fan system running, losses increased. The 27 percent greater loss rate was attributed to uninsulated duct losses to the crawl space. The effect of shuttering the window was approximately a 7 percent decrease in building loss rate.

28634 Thermal and moisture behavior of an envelope test building. Converse, A.O.; Hans, G.; Sorensen, A. (Thayer School of Eng., Dartmouth College, Hanover, NH). pp 895-912 of Proceedings of the ASHREA/DOE Conference Thermal Performance of the Exteria Envelopes of Buildings II. Atlanta, GA; A.S.H.R.A.E. (1982). (CONF-821217—).

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The double-envelope design may offer some unusual thermal performance advantages in wood-frame house construction, but its basic performance aspects, such as convective looping and ground coupling for heat distribution and storage, still are not adequately understood. Also unknown are potentially detrimental side effects associated with soil moisture gain from a crawlspace, which is often incorporated in the double-envelope design. This study was conducted to gain a better understanding of the effects of ground coupling on convective loop flow, heat balance, and degradation hazards. Data were obtained from a room-size outdoor test structure in New England which was monitored for the 1981-1982 heating season. Temperatures, solar radiation, and related data were compiled as 30-minute average values for the 4-month period. Air infiltration, humidity, and wood-moisture content were measured periodically. During February, the openings between the crawlspace and the rest of the loop were closed to test for evidence of convective loop flow in midwinter. The crawlspace floor remained bare to facilitate heat exchange with the ground and to judge the need for soilevaporation control. Crawlspace ground temperature changes showed diurnally fluctuating heat flows during winter months. In early winter there was net heat gain from the ground to crawlspace air, but in the spring this pattern was reversed. Temperature distribution showed that the convective loop was operative. Groundmoisture evaporation was slow, and the moisture content of wood framing remained in an acceptable, if high, range. Localized condensation showed need for attention to construction details.

28635 Thermal resistance of loose-fill fiberglass insulation in spaces heated from below. Besant, R.W.; Miller, E. (Department of Mechanical Engineering University of Saskatchewan Saskatoon, Canada). pp 720-733 of Proceedings of the ASHREA/DOE Conference Thermal Performance of the Exteria Envelopes of Buildings II. Atlanta, GA; A.S.H.R.A.E. (1982). (CONF-821217—).

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In this investigation a laboratory model of a house attic was used to experimentally determine the thermal resistance of blown fiberglass insulation. The attic model test cell was 12 ft. (3.66 m) square. Several types of fiberglass insulation were tested, namely cubed type, nodulated type, and batts. Cubed type insulation resembles batt insulation which has been cut up or 'cubed' into cubes with sides 3/4 to 1 1/4 in. (20 to 30 mm). Nodulated type insulation is very unlike the cubed type insulation in that it resembles wool-like fibers which are randomly orientated and which have a tendency to clump together in nodules. Energy was input at the bottom side of the insulation in the test cell by means of an electric heating element. A resistance was calculated for the insulation by determining the amount of heat flowing upward through the insulation over a measured temperature difference. The test results showed that the batts had a thermal resistance equal to the manufacturer's claim, but the loose-fill insulations had a somewhat lower thermal resistance, especially at larger temperature differences across the insulation. The thermal resistance of the insulation appeared to depend on insulation density, fiber orientation and temperature difference.

28636 Development of a simplified and manual energy calculation procedure for residences. McBride, M.F. (Owens-Corning Fiberglas Corporation, Technical Center, Granville, Ohio). pp 828-847 of Proceedings of the ASHREA/DOE Conference Thermal Performance of the Exteria Envelopes of Buildings II. Atlanta, GA; A.S.H.R.A.E. (1982). (CONF-821217—).

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A simplified calculation procedure was developed for an energy performance design system (EPDS), which can be used to predict annual heating and cooling energy consumptions of residences. The simplified procedure is an interactive computer program. A manual procedure was also developed which focuses on the performance of low-energy houses. The goal was to provide builders and designers with a procedure to evaluate the energy performance of houses while still at the design stage. The purpose of this paper is to present an overview of the approach used in development of this simplified procedure including assumptions, methodology, capabilities, and limitations. The basis for the thermal calculations was an experimentally validated, transient analysis computer program. Whole-house interactions were modeled with this hourly program. Individual components were analyzed using the appropriate subroutines from the hourly program and a simplified technique using balance-point temperatures. The individual results were generalized by correlating those values to heating and cooling degree-days plus other relevant variables. The simplified procedure was checked against 108 comparative test cases that covered three house sizes, four constructions, 11 climates, various thermostat set points, and different family sizes. The overall agreement between the hourly computer program and EPDS was remarkably good given the degree of simplification, but its strength lies in the ability to determine the relative performance of alternate features.

28637 Solar heat recovery from windows in light-frame wood construction. Hans, G.E.; Calthrope, P. (Products Laboratory, Forest Service, U.S. Department of Agriculture). pp 876-894 of Proceedings of the ASHREA/DOE Conference Thermal Performance of the Exterial Envelopes of Buildings II. Atlanta, GA; A.S.H.R.A.E. (1982). (CONF-821217—).

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Changes in thermal performance standards show growing emphasis on the need for heat-gain management in solar building designs having lightweight envelopes. This study investigated one option for such management in light-frame wood construction. Conclusions are drawn from observed field performance of two similar structures of comparable thermal mass; in one of them, solar heat recovered from a collector window was delivered to primary storage by forced airflow rather than by natural convection or radiation. Performance was judged on the basis of heat balance calculations for a 5-day midwinter period. The analytical procedure used excluded solar heat gains that led to unacceptable room temperature swings and could, therefore, no longer be considered useful. A concrete floor slab and rock bed assembly served as the primary heat storage system in both structures. During the collection cycle, the direct-gain structure showed appreciable heat flow from the floor slab to the rock bed and marked temperature differences between mass located directly in the sun and out of the sun. The resulting overheating problems were attributed to a poor load-to-storage coupling rather than to a lack of storage capacity. In the

window-heat-recovery structure, the under-floor storage was engaged more effectively; i.e., room temperatures were within an acceptable range and useful solar-gain collection capacity was markedly improved. These observations suggest that window heat recovery may be an effective option for improving solar performance of lightframe wood structures, or of any other construction system offering only limited heat storage capacity in the building envelope.

28638 **The experimentally determined effectiveness of insulation added to the exterior of residential foundations.** Wolfgram, K.J. (Dow Chemical U.S.A. Foam Products TS and D, Granville, OH). pp 527-547 of Proceedings of the ASHREA/DOE Conference Thermal Performance of the Exteria Envelopes of Buildings II. Atlanta, GA; A.S.H.R.A.E. (1982). (CONF-821217—).

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Calculations based on ASHRAE methodology suggest that an uninsulated basement wall can account for a significant portion of the overall heat loss in a typically insulated home. To determine the energy-saving effectiveness of foundation insulation, a small group of homes in Newark, OH, were retrofitted with extruded polystyrene insulation on the exterior, from 1 ft (0.30 m) below-grade up to the existing frame wall finish. The objectives of the study included determining the impact on energy usage per degree-day, the effect on savings of limited accessibility to the perimeter, how actual savings compare with those predicted by ASHRAE methodology, and the cost-effectiveness of foundation retrofitting. Savings of up to 26% were measured, and payback periods of three to four years were estimated, even though an average of only 70% of the perimeter was insulated. Surprisingly, ASHRAE methodology severely underestimates actual savings. Possible explanations for this understatement are discussed.

28639 **Retrofitted wall insulation: A state-of-the-art review.** Tsongas, G.A. (Mechanical End Dept. Portland State Univ., Portland, Oregon). pp 548-570 of Proceedings of the ASHREA/DOE Conference Thermal Performance of the Exteria Envelopes of Buildings II. Atlanta, GA; A.S.H.R.A.E. (1982). (CONF-821217—).

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This paper is a state-of-the-art review of retrofitting of wall insulation in residences. The characteristics of the available insulating materials are summarized. The influence of a variety of factors on the thermal performance of wall insulation, as well as on the overall building's energy use, is assessed. It was found that the addition of wall insulation typically reduces the overall building energy use more than is usually predicted. Numerous potential side effects are also discussed. Other concerns are addressed, including the need for infrared thermographic inspection programs and a possible derating of the R-values of insulations to account for the substantial influence of typical void areas. The fact that some insulating types seem preferable to others is noted. The advisability of utility-sponsored wall insulation retrofitting programs is discussed. Finally, recommendations for further study are presented.

28640 **Effect of insulating crawlspace walls in residential structures.** Moody, T.L.; Jennings, C.; Lamb, D. (Middle Tennessee State University, Murfreesboro, Tennessee). pp 571-585 of Proceedings of the ASREA/DOE Conference Thermal Performance of the Exteria Envelopes of Buildings II. Atlanta, GA; A.S.H.R.A.E. (1982). (CONF-821217—).

From ASHRAE/DOE conference on thermal performance of building envelopes; Las Vegas, NV, USA (5 Dec 1982).

The purpose of this study was to make in situ evaluations of the effects of insulating crawlspace walls of residential structures. The evaluation included (1) the effect of heating loss or gain through the floor for the winter and summer months, (2) the effect of eliminating crawlspace ventilation, (3) the effect of locating a central heating duct in the crawlspace, and (4) the effect of the crawlspace walls above or below grade. Homes chosen for the study were located in the same neighborhood and were of approximately the same size. In all the houses but one, used as a control, .6-mil (0.15mm) polyethylene covered the crawlspace walls and the ground. This covering was followed by a 2-in. (50.8mm) thick foil-backed duct wrap on the crawlspace walls. All the homes, including the control, were instrumented with two heatflux transducers, having an approximate sensitivity 0.9 BTU/FT²MV) 2.84 W/M²MV, under floor. Humidity and crawlspacee temperatures, as well as outdoor temperature, were monitored and and recorded continuously. In addition, the moisture content of the floor joists was measured weekly. The results of this study have revealed that: heat loss through the floor is significantly reduced in the winter, heat was conducted through the floor to the crawlspace even during the summer, and the moisture content of the floor joists was not adversely affected.

28641 **Evaluation of thermal insulating shutters by means of a guarded/calibrated hot box facility.** Miller, R.G.; Carey, R.I. (Jim Walter Research Corp., St. Petersburgh, FL). pp 617-627 of Proceedings of the ASHREA/DOE Conference Thermal Performance of the Exteria Envelopes of Buildings II. Atlanta, GA; A.S.H.R.A.E. (1982). (CONF-821217—).

From ASHRAE/DOE conference on thermal performance of building envelopes; Las Vegas, NV, USA (5 Dec 1982).

Full-scale, guarded/calibrated hot box tests were conducted on two insulated residential walls. One wall contained a double-hung, double-glazed window and the other had a sliding glass door. Both walls were tested alone and with thermal insulating shutters. Tests were run under simulated winter and summer test conditions. Results indicate that the use of thermal insulation shutters reduces heat gain or loss through a noninsulated window/wall system by about 40 percent and through a noninsulated glass door/wall system by about 70 percent.

28642 **Acoustical benefits resulting from insulation and air-leakage-control retrofits in family housing units.** Verschoor, J.D.; Haines, J.C. (Manville Service Corp., Research and Development Center, Denver, CO). pp 507-526 of Proceedings of the ASREA/DOE Conference Thermal Performance of the Exteria Envelopes of Buildings II. Atlanta, GA; A.S.H.R.A.E. (1982). (CONF-821217—).

From ASHRAE/DOE conference on thermal performance of building envelopes; Las Vegas, NV, USA (5 Dec 1982).

In an investigation sponsored by the Navy Family Housing Office, a series of tests was conducted to determine the improvement in acoustical sound transmission loss resulting from housing envelope energy conservation retrofits involving increased insulation level and/or control of air-leakage. Three wall and two roof/ceiling test structures were constructed to be representative of present-day Navy family housing units. The sound transmission loss and air-leakage rate were determined for each basic construction. Subsequently, various retrofit measures were performed. Following the retrofit, the improvements in air-leakage rate and sound transmission loss were again determined. The thermal transmittance (U value) of the base constructions and the retrofits was calculated or measured. Data are presented on the sound transmission loss, overall sound transmission class (STC), air-leakage rate, and thermal transmittance of the constructions tested. Typical (1982) retrofit costs are also estimated, along with estimates of the seasonal average heat loss, so that benefit-to-cost performance can be analyzed.

28643 **NAHB thermal performance guidelines: 1982 methodology update.** Johnson, A.W.; Johnson, R.J. (NAHB Research Foundation Inc.). pp 455-468 of Proceedings of the ASHREA/DOE Conference Thermal Performance of the Exteria Envelopes of Buildings II. Atlanta, GA; A.S.H.R.A.E. (1982). (CONF-821217—).

From ASHRAE/DOE conference on thermal performance of building envelopes; Las Vegas, NV, USA (5 Dec 1982).

The NAHB Research Foundation, Inc., developed voluntary Thermal Performance Guidelines in 1978 for the National Association of Home Builders, employing a variety of analytical procedures. In 1981 the NAHB Energy Committee initiated a program to update the guidelines, and new criteria were established. Some of these were variations on the approaches taken in 1978, while others involved totally new techniques. The 1982 guidelines were based on "zero cash flow" with a short time horizon. A price of money was estimated, as were increases in energy prices, and the effect of mortgage interest payments on income taxes was considered. Representative models of new single-family homes for the 48 continental United States were developed. Energy for space heating

and cooling was estimated to properly integrate local energy savings for each element with the energy suppliers' rate schedules, and these savings were transferred to incremental dollars. Air infiltration was discretely estimated for each locale. Results for 207 areas were printed, covering 22 envelope and eight duct elements for a variety of heating and heating and cooling combinations.

28644 **Calculating infiltration: Implications for a construction quality standard.** Grimsrud, D.T.; Sherman, M.H.; Sonderegger. (Energy and Environment Division, Lawrence Berkeley Laboratory, University of California, Berkeley, CA). pp 422-452 of Proceedings of the ASREA/DOE Conference Thermal Performance of the Exteria Envelopes of Buildings II. Atlanta, GA; A.S.H.R.A.E. (1982). (CONF-821217—). Contract AC03-76SF00098.

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Extensive work in infiltration measurement and modeling has led to a simple method to calculate the leakage area of a house regardless of design or weather conditions. The leakage area, in turn, is used in the LBL infiltration model to calculate infiltration for any weather condition. This method, which uses fan pressurization to measure the leakage area, has been used in a survey of over 300 houses located throughout North America. This paper presents the results of that survey and suggests that the present capability in infiltration modeling offers an excellent framework for an air leakage standard for residential building. Examples of the interpretation of such a standard are described based on the ventilation rates adopted in ASHRAE Standard 62-1981. The results of the interpretations illustrate differences in structural requirements that will occur when such a standard is applied to several ventilation system designs.

28645 **An in situ study of attic loose-fill thermal insulation in residential applications.** McElroy, D.L.; Graves, R.S.; Yurbrough, D.W. (Oak Ridge National Laboratory, Oak Ridge, TN). pp 343-357 of Proceedings of the ASREA/DOE Conference Thermal Performance of the Exteria Envelopes of Buildings II. Atlanta, GA; A.S.H.R.A.E. (1982). (CONF-821217—). Contract W-7405-ENG-26.

From ASHRAE/DOE conference on thermal performance of building envelopes; Las Vegas, NV, USA (5 Dec 1982).

The extent of settling of loose-fill insulations with time is being studied in 16 preinstrumented attics in Bucyrus, OH. In February 1982, immediately after installation, measurements were made of insulation depths and densities in eight attics insulated with loose-fill cellulose and eight attics insulated with loose-fill fiberglass. Depth measurements were made one, three, and six months after installation, and density measurements at six months to assess the degree of settling for the two products. The average depth of the cellulose decreased about 13% in six months; that of the fiberglass decreased about 3.4% during the same period. Average density increases are consistent with these depth changes to within 10%. Monitoring of the 16 attics is continuing.

28646 **Measured effect of forced ventilation on house infiltration rate.** Levins, W.P. (Oak Ridge National Laboratory, Oak Ridge, TN). pp 407-421 of Proceedings of the ASREA/DOE Conference Thermal Performance of the Exteria Envelopes of Buildings II. Atlanta, GA; A.S.H.R.A.E. (1982). (CONF-821217—). Contract W-7405-ENG-26.

From ASHRAE/DOE conference on thermal performance of building envelopes; Las Vegas, NV, USA (5 Dec 1982).

Tests were conducted over a period of 18 months in a house near Knoxville, Tennessee, to determine the effect of forced ventilation on the infiltration rate. An outside-vented electric dryer was used as the power vent. The testing was carried out during a variety of weather conditions. The tracer-gas technique using sulfur hexafluoride was employed to measure infiltration rates. A nonlinear regression equation was developed based on measured data relating the change in the house infiltration rate to the vent rate. The equation has the form of an inverse exponential curve showing a greater increase in the infiltration rate of a tightly constructed house than of a loosely constructed house. Calculations were made for 17 cities across the United States showing the effect of a vented electric dryer on house HVAC energy consumption.

28647 **Thermal envelope field measurements in an energy-efficient office/dormitory.** Christian, J.E. (Oak Ridge National Laboratory, Oak Ridge, TN). pp 297-324 of Proceedings of the ASREA/DOE Conference Thermal Performance of the Exteria Envelopes of Buildings II. Atlanta, GA; A.S.H.R.A.E. (1982). (CONF-821217—).

From ASHRAE/DOE conference on thermal performance of building envelopes; Las Vegas, NV, USA (5 Dec 1982).

A 4000 ft^2 (345 m^2) earth-covered structure located at the Oak Ridge National Laboratory is the focus of a DOE-sponsored building envelope research project. Heating the office/dormitory building over the 1981-1982 heating season costs \$0.16/FT^2), assuming \$0.057/KWH. The total cost for construction in 1980 dollars was about \$85/FT^2, the thermal integrity factor is 2.8 BTU/FT^{2o} (0.016 KWH/M^2 X °C). A preliminary DOE-II Model estimates the monthly electric energy needs for heating 5% of the field data derived estimates. DOE-II building simulations suggest that this earth-covered, passively heated office dormitory saves 30% for space heating and 16% for cooling compared to an "energy efficient" above-grade structure. A preliminary winter energy balance has been generated from data collected in February and March which provides a fractional breakdown of thermal losses and gains. A number of the energy-conserving components' performances have been isolated: earth-covered roof, bermed wall, nonvented Trombe wall.

28648 **Dynamics of heat losses from uninsulated basement floors in houses.** Beasant, R.W.; Hamlin, T.; Richmond, W. (Dept. of Mechanical Engineering University of Saskatchewan Saskatoon, Saskatchewan). pp 277-296 of Proceedings of the ASHRAE/DOE Conference Thermal Performance of the Exteria Envelopes of Buildings II. Atlanta, GA; A.S.H.R.A.E. (1982). (CONF-821217—).

From ASHRAE/DOE conference on thermal performance of building envelopes; Las Vegas, NV, USA (5 Dec 1982).

In this investigation, the time-varying temperatures of uninsulated basement floors in a few houses were measured and used to compute heat losses. A dynamic model was developed to illustrate the salient features of heat transfer by convection and radiation to the basement floor and its dynamic response. In this investigation, heat losses through concrete basement floors were examined in 13 houses with well insulated walls and no basement floor insulation. Of particular interest were the modes of heat transfer, the instantaneous, diurnal, and seasonal variations, as well as the total amount of heat lost. It was found by temperature measurement and air flow measurement that these basement floors lost most of their heat by radiation between the ceiling and the floor. Convection losses were small except when the forced-air circulation system jetted warm air towards the floors, which was usually the case when the furnace came on.

28649 **CIRA economic optimization methodology.** Sonderegger, R.C.; Cleary, P.G.; Dixon, J.D.; Garnier, J.Y. (Lawrence Berkeley Laboratory, University of California, Berkeley, California). pp 258-273 of Proceedings of the ASRAE/DOE Conference Thermal Performance of the Exteria Envelopes of Buildings II. Atlanta, GA; A.S.H.R.A.E. (1982). (CONF-821217—).

From ASHRAE/DOE conference on thermal performance of building envelopes; Las Vegas, NV, USA (5 Dec 1982).

CIRA is a user-friendly, microcomputer-based energy analysis and retrofitting tool for residential buildings. Aside from a monthly analysis of heating, cooling, and appliance use, CIRA can develop a list of retrofits ordered by decreasing savings-to-cost ratio for any house and any climate specified by the user. The list is terminated when no retrofits with a positive economic return remain or when a preset budget is reached, whichever comes first. This paper presents the approaches used in CIRA to deal with a number of well known problems inherent in economic optimization of buildings, such as interactions among retrofits, handling of mutually exclusive retrofits, decreasing marginal returns as more retrofits are installed, and constraints on computer time and memory for a full-scale optimization.

28650 **Basement, crawlspace, and slab-on-grade thermal performance.** Shipp, P.H. (Owens-Corning Fiberglass Corp., Technical Center, Granville, OH). pp 160-179 of Proceedings of the ASHREA/DOE Conference Thermal Performance of the Exteria Envelopes of Buildings II. Atlanta, GA; A.S.H.R.A.E. (1982). (CONF-821217—).

From ASHRAE/DOE conference on thermal performance of building envelopes; Las Vegas, NV, USA (5 Dec 1982).

The use of improved insulation and sealing procedures on the above-ground residential envelope has increased the importance of ground-coupled coupled heat exchange in the total envelope energy load. Historically, these loads have been estimated using steady-state techniques, which simplify the multidimensional nature of the heat flow paths and neglect the substantial thermal mass of the soil. These simplified procedures are best suited for estimating winter heat losses in climates with more than 3,000 annual heating degree-days. They have proven unsatisfactory, however, in estimating ground-coupled thermal performance during the cooling season for all climates. A transient, two-dimensional finite-difference program has been developed for analyzing heat transfer through the exterior envelope of the ground-coupled elements in a residence. Detailed thermal data obtained from three conditioned basements in Granville, Ohio over a 20-month monitoring period were used for experimental validation of the computer model. Using the transient analysis, a survey of the annual heating and cooling loads of a variety of basement, crawlspace, and slab-on-grade constructions was conducted. A range of climates representative of the contiguous United States was examined with each test configuration. The results are presented as a series of regression equations that express annual or seasonal energy loads as functions of insulation thermal resistance and local climatological data. Location as well as thermal resistance of the insulation is shown to have important consequences.

28651 **Annual variation of temperature field and heat transfer under heated ground surfaces: Slab-on-grade floor heat loss calculations.** (National Bureau of Standards, Gaithersburg, MD). pp 67-94 of Proceedings of the ASHREA/DOE Conference Thermal Performance of the Exteria Envelopes of Buildings II. Kusuda, T.; Bean, J.W.; Piet, O. Atlanta, GA; A.S.H.R.A.E. (1982). (CONF-821217—).

From ASHRAE/DOE conference on thermal performance of building envelopes; Las Vegas, NV, USA (5 Dec 1982).

Seasonal subsurface ground temperature profile and surface heat-transfer were determined for the condition when one and more than one region of the earth's surface temperature was disturbed. The analysis was conducted by numerical integration using a closed form solution based on the Green's function. Monthly profiles of earth temperature isotherms under a house of 20 ft by 20 ft (6.1 m by 6.1 m) floor area and under a group of six houses near a wooded area are presented. The heat losses calculated from this approach for square slabs of various sizes were compared with those derived from the recent analytical solution of Delsante et al. One of the most critical factors for the heat-transfer calculation is the temperature transition across the perimeter zone of the slab. The Delsante solution and the numerical calculation showed good agreement when the numerical calculation was made for a 6 in. linear temperature transition zone. Also included is a simplified slab-on-grade heat-transfer calculation procedure suitable for the microcomputer. This procedure was based on the Delsante's Fourier Transform Integral extending over the perimeter zone where the temperature transition takes place.

28652 **Thermal modeling and design of a dual-envelope office building.** Gujral, P.E.; Clark, R.J. (Skidmore Owings and Merrill, Chicago, IL). pp 913-927 of Proceedings of the ASHREA/DOE Conference Thermal Performance of the Exteria Envelopes of Buildings II. Atlanta, GA; ASHRAE (1982). (CONF-821217—).

From ASHRAE/DOE conference on thermal performance of building envelopes; Las Vegas, NV, USA (5 Dec 1982).

This paper describes the generation of a thermal model used to develop a dual envelope facade for an office building in Denver. The building consists of two-story spaces with an interior atrium and a glass envelope structure surrounding the roof, windows, walls, and floors, creating a channel through which air may flow. The thermal model consists of 72 heat-balance equations, which are solved simultaneously on an hour-by-hour basis utilizing a digital computer. The equations are nonlinear in that the thermal radiation and convection terms are functions of the surface-to-surface and surface-to-fluid temperatures, respectively. An exact solution of the nonlinear equations is attained by utilizing the previous 24-hr temperatures to solve for the coefficients in the steady-periodic cycle. The response of varying external envelope schemes is simulated and compared with the response of a similar building of conventional-type construction. The hourly and diurnal heat flow through the elements of the building envelope is reported for the dual-envelope scheme. Comparisons are also made of the mechanical system energy requirement for the envelope and dual-envelope schemes. The performance of the envelope building during various stages of development is reported. The results indicate that a properly designed envelope building can reduce heating energy by over 80%, compared with the conventional type construction.

28653 **Parametric analysis of energy impacts on office buildings due to climate, physical type, and occupancy characteristics.** Ander, G.D.; Sharabianlou, N. (California Energy Commission, Sacramento, CA). pp 481-503 of Proceedings of the ASHREA/DOE Conference Thermal Performance of the Exteria Envelopes of Buildings II. Atlanta, GA; A.S.H.R.A.E. (1982). (CONF-821217—).

From ASHRAE/DOE conference on thermal performance of building envelopes; Las Vegas, NV, USA (5 Dec 1982).

Section 25402 of the California Public Resources Code requires the California Energy Commission (CEC) to establish and periodically update energy-efficiency standards for new buildings. Sensitivity analyses were conducted by the Standards Development Office of the CEC for nonresidential buildings. The purpose of this parametric analysis was to determine which variations in building parameters actually have significant energy impacts. A "generic" building model was developed and implemented in conducting this sensitivity analysis. The generic model was used as an analytical tool in modeling the energy impact of building parameter variations. The parameters that were analyzed can be best described by the three major categories of (1) occupancy type (internal loads), (2) physical type (size and number of stories), and (3) weather. The preliminary analysis was concentrated on office occupancies using engineering assumptions developed by the CEC in conjunction with a five-member Technical Advisory Group and a 34-member Professional Advisory Group representing ASHREA, AIA, IES, and other professional and business organizations. The conclusions of this study revealed that the generic building model is a valid and valuable tool in analyzing the energy impacts of building parameter variations. Sixteen California climatic zones can be represented by five weather regions. Characteristics of the occupancy of office buildings can be represented by two categories: banks and low-rise offices. Variations in the physical type of office buildings can be represented by three categories: small single-story, medium to large single-story, and medium to large three-story.

28654 **Envelope strategies for a corporate headquarters office building.** Crawley, D.B. (Heery Energy Consultants, Inc., Atlanta, Georgia). pp 249-257 of Proceedings of the ASHRAE/DOE Conference Thermal Performance of the Exteria Envelopes of Buildings II. Atlanta, GA; A.S.H.R.A.E. (1982). (CONF-821217—).

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During the design development phase for a corporate headquarters office building, a number of strategies for reducing energy consumption related to envelope loads were analyzed. The energy and economic impacts of each envelope strategy were considered in developing a final recommendation for consideration by the owner. The construction costs and annual energy cost savings were included in the economic analyses conducted for each envelope strategy.

28655 **Modeling of commercial buildings for optimal regional energy conservation.** Mazzuchi, R.P.; Rauch, C.S. (Battelle Pacific Northwest Laboratory, Richland, WA). pp 787-812 of Proceedings of the ASREA/DOE Conference Thermal Performance of the Exteria Envelopes of Buildings II. Atlanta, GA; A.S.H.R.A.E. (1982). (CONF-821217—).

From ASHRAE/DOE conference on thermal performance of building envelopes; Las Vegas, NV, USA (5 Dec 1982).

The Pacific Northwest Electric Power Planning and Conservation Act mandates the preparation of a regional power plan that identifies conservation and generation resources required to meet forecasted electrical demand in the region. To support the selection of appropriate resources for future development, the Northwest Power Planning Council sponsored a preliminary assessment of conservation and supply resources in the Pacific Northwest. This study concentrates on the commercial sector assessing the energy-saving potential of energy conservation measures (ECMs) at an electrical cost-effectiveness of 150 mils/kWh by the year 2000. The evaluation procedure involves establishing building prototypes, establishing applicable energy-conservation measures and their resultant implementation costs, and evaluating potential energy savings. The measures are prioritized into a cost-effectiveness curve, and a supply function is established relating building stock, ECMs' saturation and cost, ultimately determining the cost effectiveness of conservation and generating resources.

28656 **The computerized commercial building energy and load management simulation analysis/audit system.** Lightfoot, L.J. (Arizona Public Service Company, Phoenix, AZ). pp 769-786 of Proceedings of the ASHREA/DOE Conference Thermal Performance of the Exteria Envelopes of Buildings II. Atlanta, GA; A.S.H.R.A.E. (1982). (CONF-821217—).

From ASHRAE/DOE conference on thermal performance of building envelopes; Las Vegas, NV, USA (5 Dec 1982).

The computerized commercial building energy and load management simulation analysis/audit system consists of two building analysis programs developed on a small microprocessor: the energy consultation program (ecp) and computerized commercial energy analysis (ccea) simulation program. The system is an integral part of an Arizona utility company's load management program to permanently reduce power plant capacity by 2,170,800 MJ/hr (603 megawatts) by 1992. Ecp is used initially to screen a facility's energy use and load profile. This profile is compared against energy consumption and peak demands of similar businesses within one of four climatic regions located in the utility's service area. Ccea's thermal analysis is based on the characteristics of a structure, including: building materials, component size, shape, external surface color, location, structure orientation, external shading, and indoor conditions such as temperature, ventilation rates, lighting schedules, and occupant/equipment profiles that contribute to the internal thermal loads. An ASHRAE-modified degree-day method is employed to simulate the heating and cooling loads. Six-hour temperature and solar insolation data averages from each climatic zone are used in the simulation.

28657 **The air infiltration and ventilation rates in two large commercial buildings.** Grot, R.A. (Center for Building Technology, National Bureau of Standards, Washington, DC). pp 391-406 of Proceedings of the ASHREA/DOE Conference Thermal Performance of the Exteria Envelopes of Buildings II. Atlanta, GA; A.S.H.R.A.E. (1982). (CONF-821217—).

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This article presents data on the air infiltration and ventilation rates in two large commercial buildings. One building is a 4-story, approximately 107,600 ft^2 (10,000 m^2) office building located outside of Glasgow, Scotland; the other is a 26-story, approximately 1,076,000 ft^2 (100,000 m^2) skyscraper located in downtown Newark, N.J. The data on the air infiltration and ventilation rates in these buildings were collected by a microcomputer-based automated air infiltration system, which controlled the injection of a tracer gas into the various zones of the building and monitored its decay. In addition to the data on air exchange rate produced by analysis of the tracer decay data, the microcomputer also monitored the operation of the building's HVAC systems, the interior temperature, building envelope surface pressures, the exterior temperature, and wind speed and direction.

28658 **A simple calculation for obtaining the number of degree-days at arbitrary base temperatures.** (Univ. of Kansas, Dept. of Mechanical Eng., Lawrence, KS). pp 21-38 of Proceedings of the ASHREA/DOE Conference Thermal Performance of the Exteria Envelopes of Buildings II. Phillips, R.K.; Gordon, M.C.; Linquist, E.G. Atlanta, GA; A.S.H.R.A.E. (1982). (CONF-821217—).

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Degree-day data versus base temperature are analyzed for several hundred locations in the United States. For nearly all locations, the data are found to be represented accurately by a simple power function. The power function coefficients are tabulated for each location. Errors between the actual degree-day data and the values predicted by the power function are analyzed. In general, these errors are small (of the order of 1%). The resulting power functions are useful for determining the number of degree-days at various base temperatures at a given location, allowing a table of degree-days versus base temperature to be replaced by a simple equation. This equation will be useful in both hand and computer calculation of (1) heating energy usage by the balance point method, (2) effects of heating thermostat setbacks, and (3) infiltration losses in plants and warehouses that are not heated to 68°F (20°C).

28659 **The thermal mass-transfer coefficient and equilibrium moisture content of insulating materials.** Benner, S.M.; Luu, D.V. (Drexel Univ., Philadelphia, PA). pp 1052-1062 of Proceedings of the ASHREA/DOE Conference Thermal Performance of the Exteria Envelopes of Buildings II. Atlanta, GA; A.S.H.R.A.E. (1982). (CONF-821217—).

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Since moisture can diminish the thermal performance of an insulating system, it is necessary to understand the mechanisms involved in moisture behavior in insulating materials. Toward this end, this research project studied two parameters of hygroscopic moisture transfer: (1) the equilibrium moisture content (EMC) and (2) the thermogradient coefficient. EMC is dependent on the temperature and humidity of the surrounding air, and a plot of EMC versus humidity is known as an isotherm. Isotherms were determined for two densities of glass fiberboard 8.63 and 6.31 lb/ft^3 (138 and 101 kg/m^3) at 86°F (30°C) and 104°F (40°C). It was found that the EMC is greater for desorption than for sorption, decreases with an increase in temperature, and is greater for higher density fiberboard. The EMC for glass fiberboard is less than 1.5% by weight for temperatures above 86°F (30°C) and humidities below 90%. A sample of 8.63 lbs/ft^3 (138 kg/m^3) density glass fiberboard was subjected to a thermal gradient of 47F° (26C°). The results showed that the temperature versus moisture distribution of the sample was linear and that the thermogradient coefficient in the hygroscopic zone was on the order of 0.01 to 0.017 lbs/lbF° (0.02 to 0.03 kg/kgC°). The coefficient is dependent on the average moisture content, increasing with increasing moisture.

28660 **Exploitation of ground climate for energy efficient building design.** Labs, K. (Undercurrent Design Research New Haven, Connecticut). *Alternative Energy Sources;* 7: 19-37(Dec 1980). (CONF-801210—).

From 3. Miami international conference on alternative energy sources; Miami Beach, FL, USA (15 Dec 1980).

The role of earth sheltering is discussed as it relates to fundamental strategies of climate control. A method of weather data analysis is presented along with the results of the analysis for four different cities in the United States. Also presented is a model for predicting ground temperature at any depth or over any profile range. Ground temperature tables for the same four cities in the United States are included to present a complementary view of above and below ground climate.

28661 **Habitability and energy performance of earth sheltered dwellings.** Boyer, L.L.; Grondzik, W.T. (School of Architecture Center for Natural Energy Design Oklahoma State University Stillwater, Oklahoma). *Alternative Energy Sources;* 7: 39-64(Dec 1980). (CONF-801210—).

From 3. Miami international conference on alternative energy sources; Miami Beach, FL, USA (15 Dec 1980).

The High Plains region of the central United States has become host to an emerging dwelling concept which incorporates the use of earth shelter technologies. Traditionally, inhabitants of this region have been sensitized to the need for windstorm protection. More recently, dramatic potentials for energy savings have served as a strong secondary inducement to the exploration of earth sheltered housing as an energy alternative. Habitability and passive energy design of earth sheltered structures are key focal elements being investigated at Oklahoma State University. Habitability aspects have received little treatment elsewhere, and existing passive energy design strategies have generally not considered the passive cooling benefits of earth sheltered construction. Extended questionnaires were used to obtain earth sheltered occupant responses to both habitability and energy design aspects including measured energy usage. Preliminary analysis has been completed on about 80 (eighty) projects in the State of Oklahoma, and the study is being extended to 8 (eight) additional surrounding states. Initial results indicate that occupants are generally satisfied with such attributes as structural safety, thermal comfort, and acoustical environment; but have some reservations concerning daylighting, site design, and energy design and performance. Energy usage patterns tend to indicate that, in fact, sizeable savings are being realized by owners of current generation earth shelters. However, it is anticipated that with optimized passive systems design, the presently realized savings could be further increased by perhaps a factor of two. An appropriate design balance must be realized between passive heating and passive cooling needs.

28662 **Trends in the conservation of energy in the United States, 1965-1980.** Walton, H.L. (Office of Program Development Energy Information Administration Department of Energy Washington, DC). *Alternative Energy Sources;* 7: 119-138(Dec 1980). (CONF-801210—).

From 3. Miami international conference on alternative energy sources; Miami Beach, FL, USA (15 Dec 1980).

This paper focuses on empirical evidence of conservation actions (motivated by price, costs, regulations, or for any reason) in the United States, with special emphasis on the post 1973-1974 period. An overview of total energy use by economic sector-residential, commercial, industrial, and transportationis presented. Gross indicators of energy intensity are tracked over the time period 1965-1979. Purchase of conservation and more fuel efficient equipment are described. Finally, increased uses of renewable resources are documented. Sources of information include newly developed (or modified) data collection systems initiated by the Department of Energy (or by the Bureau of Census at DOE's request), the Department of Transportation, the Internal Revenue Service, and the Environmental Protection Agency.

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REFER ALSO TO CITATION(S) 28539, 28697, 28698

28663 **(BMFT-FB-T—83-284) Restraint systems for 'Telebus'.** Appel, H.; Grunewald, H.J. (Bundesministerium fuer Forschung und Technologie, Bonn (Germany, F.R.)). Dec 1983. 24p. (In German). NTIS (US Sales Only), PC A02/MF A01. Order Number DE84751229.

Portions are illegible in microfiche products; With 1 tab., 11 figs.

Four different restraint systems were designed, constructed, built and tested for the use in vehicles built especially for transportation of handicapped persons. A restraint system with rear and side support was choosen. This restraint system is characterized by its easy handling and the minimum space requirement. The effectiveness of the choosen system was demonstrated in 31 collision tests. Accelerations of the dummy and the test sled were measured as well as forces of the restraint system for persons and for wheelchairs. The passenger restraint system was a three-point seat belt, for the wheel-chair restraint system belts and steel ropes were used. Further development of this system with regard to weight, flexibility, appearance and simplification is possible.

28664 **(PB—84-152610) Estimating transportation energy consumption of residential land types. Final report.** (Dane County Regional Planning Commission, Madison, WI (USA)). Feb 1983. 122p. NTIS, PC A06/MF A01.

This report is the result of a demonstration project in Dane County, Wisconsin, which examined the relationships between residential land use development and transportation related energy consumption. To face the dilemma between encouraging development to improve the local tax base and the need to maintain efficient travel without overloading limited community resources, a simple set of factors describing transportation energy consumption per dwelling unit, for a range of differing residential densities and locations, were developed. The technique is presented in such a manner that other regions can replicate the process to produce factors specific to their areas. It also provides a means to report energy consumption factors and impacts to State and local officials concerned with the planning process for transportation.

28665 **(PB—84-152628) Transportation energy management: current transit operator activities.** (Municipality of Metropolitan Seattle-METRO, WA (USA)). Sep 1982. 42p. NTIS, PC A03/MF A01.

Due to the rapid rise in the price of energy during the 1970's, transit operators have initiated a variety of activities designed to improve management of their energy use. This report describes the results of a national survey of energy management activities undertaken by 100 transit systems in the United States and Canada. The survey reports on activities in five areas: energy crisis contingency planning; energy conservation in bus maintenance, repair and operating facilities; energy conservation petroleum fueled bus fleets; energy conservation awareness programs; and fuel supply and price protection strategies. The report presents the survey methodology and respondent characteristics, survey results and the questionnaire.

28666 **(PB—84-152644) Transportation energy contingency planning: emergency fuel storage.** (Municipality of Metropolitan Seattle-METRO, WA (USA)). Jan 1983. 84p. NTIS, PC A05/MF A01.

See also PB84-152636.

This report is designed to provide information on means of assessing the feasibility of and planning for improved fuel storage as a contingency strategy. It also highlights a number of benefits of enhanced storage which can be achieved in normal day-to-day transit operations. Regardless of the circumstances underlying a fuel emergency, managers need to know they can provide suitable transit services quickly, confidently and effectively. A specially-designated transit fuel set-aside, or some combination of permanent reserve storage and assured emergency supply arrangements will go far in providing bus properties with the emergency response capability they so urgently require.

28667 **(PB—84-163872) Fuel economy testing of six 40-foot transit buses. Final report Aug 82-Mar 83.** Francis, G.A.; Nelson, S.R. (Battelle Columbus Labs., OH (USA)). Mar 1983. 97p. NTIS, PC A05/MF A01.

The importance of life-cycle cost analyses in transit bus procurement is recognized by the industry and has been a Congressional requirement for grantees. This report documents a program of fuel economy testing of six standard 40-foot buses. The main purpose of this series of tests is to assist transit authorities and bus suppliers by providing accurate comparable fuel consumption data on transit buses produced by different manufacturers. Six buses were selected by the manufacturers and supplied for testing by six transit properties directly from revenue service. This report makes the data available to the industry for discretionary use in estimating life-cycle costs. A list of bus manufacturers and the supplying transit system is provided.

3203 Industry And Agriculture

REFER ALSO TO CITATION(S) 27781, 28033, 28547, 28608, 28623, 28659, 28662, 29312

28668 (BMFT-FB-T—83-304) Measures to encourage waste heat utilization in German industry. Brike, F. (Bundesministerium fuer Forschung und Technologie, Bonn (Germany, F.R.)). Dec 1983. 97p. (In German). NTIS (US Sales Only), PC A05. Order Number DE84751232.

Paper copy only, copy does not permit microfiche production; With 10 tabs., 22 figs.

The present study originated from the controversy around the so-called "waste heat levy". It was the intention to impose a charge on the operation of industrial installations by means of waste-heat related taxes in order to penalize such emission to the environment. The investigation was subdivided into three stages: a) determination and evaluation of industrial waste heat potential in the various industrial sectors; b) technical and economical investigation of technologies for waste heat utilization in selected industrial sectors; c) comparative study of administrative instruments to encourage waste heat utilization, with special emphasis on the waste heat levy.

28669 (BMFT-FB-T—84-035) Study about the practicability of thermal treatment of paint sludge and the state of present waste management and disposal technology. Nijs, G. (Bundesministerium fuer Forschung und Technologie, Bonn (Germany, F.R.)). Feb 1984. 145p. (In German). NTIS (US Sales Only), PC A07/MF A01. Order Number DE84751503.

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The amount of paint sludge produced in the Federal Republic of Germany ranges between 135.000 and 150.000 tons per year. Special refuse-pits play the dominating part at the disposal of paint sludge. Only 20% of it could possibly be disposed of by incineration. It can be foreseen that in future the use of acrylates, DD-paints, hydro-paints as well as electrostatical techniques will be increased. The thermal treatment of moist paint sludge by burning it in the ceramic hearth and pyrolysis in the fixed bed reactor are problematical or not practically. The thermal treatment of dried paint sludge by fluidized bed pyrolysis can be realized economically. Pyrolysis gas, pyrolysis oils with a portion of aromatics of 99,5% and pyrolysis coke are produced as marketable pyrolysis products.

28670 (CONF-840434—1) Determination of thermal-degradation rates of some candidate Rankine-cycle organic working fluids for conversion of industrial waste heat into power. Jain, M.L.; Demirgian, J.; Krazinski, J.L.; Bushby, H.; Mattes, H.; Purcell, J. (Argonne National Lab., IL (USA); Department of Energy, Washington, DC (USA)). 15 Apr 1984. Contract W-31-109-ENG-38. 16p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE84009585.

From 6. annual industrial energy conservation technology conference; Houston, TX, USA (15 Apr 1984).

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Serious concerns over the long-term thermal stability of organic working fluids and its effect on system performance, reliability, and overall economics have impeded widespread development and deployment of organic Rankine-cycle power systems (ORCPSs) for conversion of industrial waste heat into power. Prototype systems built using thermal-stability information derived from static capsule tests have often operated less than satisfactorily. This investigation is an attempt by the US Department of Energy (DOE) to alleviate these fears, dissipate the remaining road blocks, and accelerate the further development and deployment of this vital industrial energy-conservation technology. This paper presents some interim results of an experimental investigation undertaken to determine degradation rates (as a function of maximum cycle temperature) of four organic working fluids considered potential candidates for use in a Rankine-cycle power-conversion system. The four fluids under investigation are Fluorinol 85, 2-methylpyridine/water, toluene, and Freon R-113.

28671 (DOE/CE/40596—T1, pp 163-169) Cooling towers: the overlooked energy conservation machine. Burger, R. 1982. Association of Energy Engineers, 4025 Pleasantdale Rd, Suite 340, Atlanta, GA 30340. Order Number DE84003526. TI84003526

In Advances in energy productivity. Proceedings of the 5th World Energy Congress, September 14-17, 1982.

The elements involved in upgrading cooling tower performance are reviewed briefly and the conventional construction is compared with modern day technology. The three major elements investigated are air handling, water distribution, and heat transfer surfaces. The upgrading of these elements are investigated in order of ascending costs and then case histories are presented to document the rapid return of investment (ROI) by optimizing the performance of the cooling tower. (MHR)

28672 (DOE/CS/40330—T1) Technology acceleration program for the GTE ceramic high-temperature recuperator. Final report. Dorazio, R.; Ferri, J.; Fulkerson, W.; Gonzalez, J.; Kohnken, K.; Mahoney, W. (GTE Products Corp., Towanda, PA (USA). Chemical and Metallurgical Div.; SEE CODE- 9512127 Par Enterprises, Inc., Fairfax, VA (USA)). Mar 1983. Contract FC01-80CS40330. 224p. NTIS, PC A10/MF A01; GPO Dep. Order Number DE84007608.

This TAPHTR (Technology Acceleration Program for high temperature recuperators) final report describes the GTE ceramic recuperator and each of 38 industrial furnace installations and discusses the economics of each installation. In addition, descriptions are provided for other recuperation system components, such as, burners, combustion controls, etc., that were used in this program. A market assessment was conducted to provide information on the possible applications of the GTE ceramic recuperator.

28673 (DOE/R7/01168—T1) Cogeneration for existing alfalfa processing. (Olsson Associates, Lincoln, NE (USA)). 1984. Contract FG47-80R701168. 43p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE84010006.

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This study is designed to look at the application of gas-turbine generator cogeneration to a typical Nebraska alfalfa processing mill. The practicality is examined of installing a combustion turbine generator at a plant site and modifying existing facilities for generating electricity, utilizing the electricity generated, selling excess electricity to the power company and incorporating the turbine exhaust flow as a drying medium for the alfalfa. The results of this study are not conclusive but the findings are summarized.

28674 (EGG-PBS—6579) Survey and assess.nent of heat of reaction type chemical heat pumps. Sanders, R.D. Jr.; Suciu, D.F.; Toth, W.J.; Wikoff, P.M. (EG and G Idaho, Inc., Idaho Falls (USA)). Apr 1984. Contract AC07-76ID01570. 65p. NTIS, PC A04/MF A01; GPO Dep. Order Number DE84010988.

A substantial need exists for the development of technology to augment a significant portion of the manufacturing fuel requirements with the low grade energy contained in the industrial process waste heat streams. The potential economic and strategic benefits of such technologies have served as the impetus for the investigation of the development of mechanical and chemical heat pumps for industrial application. This report is the result of a survey of the state-of-the-art and an assessment of heat of reaction chemical heat pump systems (HRCHP). HRCHP systems are only conceptual at this time; no HRCHP systems have been developed, and no significant laboratory or development efforts have taken place. However, survey efforts indicate significant potential for such systems. The assessment has resulted in identification of 200 potential reactions. A computer program for the thermodynamic analysis of these reactions has been developed as well as preliminary conceptual designs for the Cyclohexane-Benzene and the Isopropanol-Acetone Chemical Heat Pumps. HRCHP's, using reactions in common use in the chemical industry, appear capable of heat pumping to higher temperatures than conventional chemical or mechanical heat pumps. For example, the Isopropanol Acetone HRCHP is capable of a 216°F temperature boost with a Carnot efficiency of 65%. Further screening of the technology, feasibility studies and engineering

studies are warranted by the potential energy savings associated with HRCHP's.

28675 **(NP—4770257) Non-polluting disposal of spent primary batteries.** Hiller, F. (Varta Batterie A.G., Hannover (Germany, F.R.)). 1982. 7p. (In German). NTIS (US Sales Only), PC A02/MF A01. Order Number DE84770257.

Reflections on non-polluting disposal of spent primary batteries result in the following: Mercury content of battery systems which are either available on or being introduced to the market varies extremely. Coal/zinc cells, i.e. Leclanche cells and lithium cells, contain practically no mercury. A system for collecting and recycling cells with an increased mercury content (HgO/Zn cells) has existed for year. The mercury content of a cell does not mean ony hazard for the user. The following strategy, therefore, appears to be applicable for spent batteries: - collection and recycling of mercury oxide and silver oxide button cells, - disposal of zinc/coal batteries with domestic refuse, - quantitative reduction of alkaline zinc/manganese dioxide cells through substitution.

28676 **(NP—4770258) Recycling of Ni-Cd batteries.** Hiller, F. (Varta Batterie A.G., Hannover (Germany, F.R.)). 1982. 6p. (In German). NTIS (US Sales Only), PC A02/MF A01. Order Number DE84770258.

The spent, open Ni/Cd large-size cells are almost completely collected and reprocessed as will the gas-tight small-size cells to a certain proportion. About 70% of the cadmium obtaining from batteries in the Federal Republic of Germany are already kept away from the environment. Substitution of the Ni/Cd accumulator or of the cadmium anode is not possible owing to their special battery properties. Their limited replacement by high-energy long-lived primary cannot may well occur in future. In principle, cadmium-free and low-mercury primary batteries can be exchanged for almost all Ni/Cd cells.

28677 **(ORNL/Sub—78-7229/5) Research and development of energy-efficient high back-pressure compressor.** (Kelvinator Compressor Co., Grand Rapids, MI (USA)). Sep 1983. Contract AC05-84OR21400. 93p. NTIS, PC A05/MF A01; 1; GPO Dep. Order Number DE84011827.

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Improved-efficiency compressors were developed in four capacity sizes. Changes to the baseline compressor were made to the motors, valve plates, and mufflers. The adoption of a slower running speed compressor required larger displacements to maintain the desired capacity. This involved both bore and stroke modifications. All changes that were made to the compressor are readily adaptable to manufacture. Prototype compressors were built and tested. The largest capacity size (4000 Btu/h) was selected for testing in a vending machine. Additional testing was performed on the prototype compressors in order to rate them on an alternate refrigerant. A market analysis was performed to determine the potential acceptance of the improved-efficiency machines by a vending machine manufacturer, who supplies a retail sales system of a major soft drink company.

28678 **(ORNL/TM—9098) Economic feasibility of recycling plastic wastes: preliminary assessment.** Curlee, T.R. (Oak Ridge National Lab., TN (USA)). Apr 1984. Contract AC05-84OR21400. 81p. NTIS, PC A05/MF A01; 1; GPO Dep. Order Number DE84011855.

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Preliminary conclusions concerning the economic feasibility of recycling plastic wastes are presented. In addition to assessing if current recycle technologies can compete in an economic sense with current disposal technologies, the paper attempts to project the quantities of the various types of plastic wastes that may be suitable for the different recycle technologies. Three preliminary conclusions are drawn. First, during the 1985 to 1990 time period only about 25% of the total quantity of plastic wastes can be easily diverted from the municipal waste stream. Second, the data currently available indicate that several recycle processes are competitive with currently used disposal processes. Third, recycle processes that utilize municipal wastes are not clearly inferior to recycle processes that utilize relatively uncontaminated plastic wastes. The paper concludes with suggestions for future research in this area.

28679 **(PB—84-151653) Ceramic tube materials and processing development. Annual report Feb-Oct 82.** Roy, D.W.; Green, K.E.; Oliver, R.E.; Rivkin, M.I. (Coors Porcelain Co., Golden, CO (USA)). Dec 1983. 40p. NTIS, PC A03/MF A01.

Evaluation of state-of-the-art in ceramic recuperator design and application, including the current requirements (specifications) for reaction bonded SiC tubing. Discussion of the perceived joining problem(s) and comments on possible solutions. Initial examination of low cost raw materials and qualitative discussion of the ceramic produced from selected grades of same.

28680 **(PB—84-152057) Manual ahorro de energia en la industria (Energy conservation manual for industry).** (Corporacion de Fomento de la Produccion, Santiago (Chile)). 1983. 200p. NTIS, PC A09/MF A01.

This manual gives general guidelines on which to base an energy conservation program, signals situations and opportunities for energy savings in an industrial plant, provides information for easy quantification of energy loss, and signals how to correct deficiencies in certain important aspects such as combustion and insulation. One chapter deals with heat audits, an extremely useful tool for identifying areas on which one should concentrate to achieve energy savings. The manual also describes general heating systems with a view to pointing out ways to increase efficiency and eliminate defects, including steam systems and oil, coal, and firewood combustion.

28681 **(PB—84-159391) Evaluation of the feasibility of incinerating hazardous waste in high-temperature industrial processes. Final report.** Hall, F.D.; Kemner, W.F.; Annamraju, G.; Krishnan, R.; Taft-Frank, M. (PEDCo-Environmental, Inc., Cincinnati, OH (USA)). Feb 1984. 260p. NTIS, PC A12/MF A01.

In the search for disposal alternatives, the U.S. Environmental Protection Agency is evaluating the potential use of high-temperature processes for the incineration of hazardous wastes. Many kinds of waste have already been disposed of in boilers and cement kilns; this report considers the many other potential processes, such as metallurgical furnaces, brick and lime kilns, glass furnaces, and sewage sludge combustors. Each process is examined against such criteria as time/temperature profile, geographical location, product quality considerations, institutional factors, and environmental impacts. Promising alternatives are identified.

28682 **(PB—84-163120) Energieverbruik in de textielnijverheid (The consumption of energy in the textile industry). Final report.** Bettens, G. (Centre Scientifique et Technique de l'Industrie Textile Belge (CENTEXBEL), Brussels). 1984. 38p. NTIS, PC E04/MF E04.

Figures are given for the consumption and cost of energy in the Belgian textile industry. The main energy users are identified as the wet processes such as dyeing. A brief survey of mechanical processes such as yarn and fabric manufacture is given showing where economies can be made by running at a slower speed and using modern machinery. The wet processes are dealt with in more detail and general indications are given of how economies in energy consumption can be made. Modifying processes, reducing water consumption and improving drying techniques are three examples. The principles are outlined of heat recovery giving figures from industry of the kind of savings that can be made using heat exchangers.

28683 **(PB—84-163898) Development of criteria for extension of applicability of low emission, high efficiency coal burners: second annual report. Report for Oct 78-Sep 79.** Brienza, A.; Chen, S.; Heap, M.; Lee, J.; Nurick, W. (Energy and Environmental Research Corp., Irvine, CA (USA)). Feb 1984. 209p. NTIS, PC A10/MF A01.

The report, describing the second year's effort under this contract, concerns the development of criteria for the evaluation and applicability of low-emission, high efficiency coal burners. The

report describes progress in three major areas: (1) bench scale studies, (2) distributed mixing burner (DMB) development, and (3) comparison with commercial practice. No operability problems were encountered with different fuel types, but NO emissions were fuel dependent. Several commercial burners were tested satisfactorily in the test facility.

28684 **(PNL—4571) Review of studies of research opportunities in energy conservation.** Hane, G.J.; Williams, T.A.; Hauser, S.G. (Pacific Northwest Lab., Richland, WA (USA)). Apr 1984. Contract AC06-76RL01830. 116p. NTIS, PC A06/MF A01; 1; GPO Dep. Order Number DE84011525.

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This study attempted to systematically identify, screen and review many of the 27 remaining major studies across the end-use areas. The method used to identify and review the studies, the scope of this effort, the types of studies reviewed, and the R and D opportunities identified are discussed. The actual report reviews are included. The review format and the kinds of information sought from each report are discussed. The general categories of the material are described; the types of information presented are summarized; and gaps in the literature are discussed. A discussion of R and D needs and comments of the specific needs presented and their temporal and evolutionary characteristics are included. The findings of the review are summarized and the researchers contacted for information are listed.

28685 **(PNL—4912) Characterization of industrial process waste heat and input heat streams.** Wilfert, G.L.; Huber, H.B.; Dodge, R.E.; Garrett-Price, B.A.; Fassbender, L.L.; Griffin, E.A.; Brown, D.R.; Moore, N.L. (Pacific Northwest Lab., Richland, WA (USA)). May 1984. Contract AC06-76RL01830. 224p. NTIS, PC A10/MF A01; 1; GPO Dep. Order Number DE84012223.

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The nature and extent of industrial waste heat associated with the manufacturing sector of the US economy are identified. Industry energy information is reviewed and the energy content in waste heat streams emanating from 108 energy-intensive industrial processes is estimated. Generic types of process equipment are identified and the energy content in gaseous, liquid, and steam waste streams emanating from this equipment is evaluated. Matchups between the energy content of waste heat streams and candidate uses are identified. The resultant matrix identifies 256 source/sink (waste heat/candidate input heat) temperature combinations. (MHR)

28686 **(TVA/OP/EDT—84/14) Power factor controller laboratory performance test report.** (Tennessee Valley Authority, Chattanooga (USA). Div. of Energy Demonstrations and Technology). 1984. 49p. NTIS, PC A03/MF A01. Order Number DE84901077.

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Electric motors consume approximately two-thirds of the electric energy produced in this country. This fact, coupled with the spiraling costs of energy, has caused a proliferation of energy-saving devices and other energy conservation techniques for motors to show up in the market place. The objective of this program is to research, develop, test, and demonstrate promising methods of increasing the efficiency of electric motors and pumps. The National Aeronautics and Space Administration (NASA) Power Factor Controller (PFC) was chosen for laboratory and field testing as the first step in this program. This report presents the results of the laboratory testing program.

28687 **Simple economics of industrial cogeneration.** Joskow, P.L.; Jones, D.R. (Massachusetts Inst. of Tech., Cambridge). *Energy Journal;* 4: No. 1, 1-22(Jan 1983).

The authors develop a series of simple models of a typical cost-minimizing industrial firm's decision to invest in cogeneration facilities. They identify the critical technical and economic variables affecting this decision and how these variables interact with one another. The model provides a useful framework for evaluating economical cogeneration opportunities and public policies designed to promote cogeneration. The conclusions are that (1) the energy savings and related thermodynamic properties of cogeneration alone do not indicate an attractive choice for industrial firms; (2) the economics are sensitive to absolute and relative values for fuel costs and electricity costs: (9993) the economics depends on the technical characteristics of the plants where cogeneration will be used; and (4) different cogeneration technologies imply different amounts of electricity production for any particular level of process steam cogenerated. 22 references, 2 figures, 2 tables.

28688 **Process energy conservation manual.** Payne, F.W. (ed.). Atlanta, GA; Fairmont Press Inc. (1983). 157p. (DOE/CS/40104—T2). NTIS, PC A08/MF A01; 1; GPO Dep. Order Number DE84011692. Contract AC01-76CS40104.

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The current status of computer technology is assessed in terms of its applicability for industrial energy conservation, including direct and peripheral costs, economic analysis, and selection criteria. Details of conservation techniques available for distillation processes are provided, covering both managerial and engineering approaches for reducing energy consumption. Energy efficient technologies are examined which may be applied in the regeneration of granular activated carbon, including a detailed assessment of thermal regeneration technology and complete analysis of energy conservation options available. A comprehensive report is provided on Western European energy conservation technologies for evaporators, with an examination of current practices, heat recovery applications, and guidelines for assessing and implementing upgrading projects. (MHR)

28689 **An analysis of the factors influencing industrial energy conservation.** Uri, N.D. (Office of Applied Analysis/EIA U.S. Department of Energy Washington, DC). *Alternative Energy Sources;* 7: 99-117(Dec 1980). (CONF-801210—).

From 3. Miami international conference on alternative energy sources; Miami Beach, FL, USA (15 Dec 1980).

It is extremely important to make a precise, quantitative assessment of the impact of the myriad of factors affecting the improvement in industrial energy efficiency. The best that can be done is to qualitatively show that changing product mix, variations in capacity utilization, and energy price increases had an impact on the efficiency with which energy was used in the manufacturing process for the ten most energy intensive industries in the period 1971 to 1976.

28690 **Energy, capacity and economic effects of cogeneration interfaced with electric utility systems.** Van Kuiken, J.; Hub, K. (Energy & Environmental Systems Division Argonne National Laboratory Argonne, Illinois). *Alternative Energy Sources;* 7: 391-398(Dec 1980). (CONF-801210—).

From 3. Miami international conference on alternative energy sources; Miami Beach, FL, USA (15 Dec 1980).

The objective of this paper is to discuss potential energy saving, capacity credits, and economic impacts of various arrangements for electrical power supply between utilities and small power cogenerators. The approach is to use a methodology consistent with those used by utilities in their reliability and generation cost analysis. Emphasis is placed on qualitative observations derived from detailed simulation investigations.

28691 **Cogeneration/District heating-the opportunity and the challenge.** Savage, W.F. (Office of Advanced Nuclear Systems and Projects U.S. Department of Energy Washington, DC). *Alternative Energy Sources;* 7: 399-405(Dec 1980). (CONF-801210—).

From 3. Miami international conference on alternative energy sources; Miami Beach, FL, USA (15 Dec 1980).

The Departments of Energy and Housing and Urban Development have undertaken a major new initiative to accelerate the implementation of district heating in cities throughout the United States. District heating is a system for the distribution of thermal energy from a central source to residential, commercial, and industrial users. A proposed National district heating program has the potential to conserve scarce fuels by (1) substituting alternative sources of energy for the oil and natural gas that are now burned in

individual buildings, and (2) more efficiently utilizing existing energy sources through the use of cogeneration powerplants. Over 90 percent of the energy required for space and hot water heating in the United States is supplied by oil and natural gas. A district heating system not only can provide energy for space heating, industrial process heat, and hot water, it can also be used for cooling purposes by absorption chilling. Energy sources for district heating include coal, nuclear, industrial waste heat, solid wastes, geothermal reservoirs, and solar radiation.

28692 **Present research advances in coal-burning gas turbines.** Tabakoff, W. (Department of Aerospace Engineering and Applied Mechanics University of Cincinnati, Cincinnati, Ohio). *Alternative Energy Sources;* 6: 315-332(Dec 1980). (CONF-801210—). Contract AC01-76ET10620.

From 3. Miami international conference on alternative energy sources; Miami Beach, FL, USA (15 Dec 1980).

With increasing interest in the burning of coal in industrial gas turbines, there is also concern for the determination of the erosive effects on the turbine components. In order to provide the basis for alloy selection in future turbines using coal, an investigation is undertaken to obtain a basic understanding of the mechanisms of erosion at high temperatures. For this purpose, test equipment has been designed to simulate the aerodynamic and thermodynamic conditions in the turbine. Data were obtained for 304 stainless steel, Rene 41 and A286 alloys at temperatures between ambient and 1200°F. In addition, the equations that govern the three-dimensional motion of the solid particles suspended by a compressible gas flow through a rotating cascade of a turbomachine, are formulated. These equations are solved for the case of flow through a turbine stage. The solution takes into account the loss in particle momentum due to their collision with the turbine blade casing. The results obtained from this study indicate the locations on the turbine blades subjected to erosion damage.

3206 Municipalities And Community Systems

REFER ALSO TO CITATION(S) 28052, 28257, 28533, 28555, 29053, 29497

28693 **(AD-A—137224/2) Long-term evaluation heat recovery incinerator system - Jacksonville - December 1982 - May 1983. Final report Dec 82-May 83.** Leipert, D.; Parker, Z. (VSE Corp., Oxnard, CA (USA)). Dec 1983. 29p. NTIS, PC A03/MF A01.

This report is the second report which addresses the long term evaluation of the NAS Jacksonville Heat Recovery Incinerator. Operational data was collected from December 1982 to May 1983 and then analyzed for reliability, availability, and maintainability.

28694 **(DOE/CS/20074—T1) Moorhead District Heating Project, City of Moorhead, Minnesota. Report on reference design.** (Edeskuty (Joseph V.) and Associates, Minneapolis, MN (USA)). 22 Mar 1982. Contract AC02-78CS20074. 144p. NTIS, PC A07/MF A01; 1; GPO Dep. Order Number DE84010364.

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The reference design includes the folowing: power plant retrofit, distribution system, small consumer connections, and Moorhead State University boiler plant retrofit for hot water standby. (MHR)

28695 **(ORNL/TM—9013) Environmental aspects of district heating/cogeneration in the twin cities.** McLain, H.A.; Secora, D.N.; Sharp, R.D.; Kornegay, F.C.; Myers, M.L.; Churnetski, E.C. (Oak Ridge National Lab., TN (USA)). Apr 1984. Contract AC05-84OR21400. 183p. NTIS, PC E08/MF A01; GPO Dep. Order Number DE84012036.

Includes 4 sheets of 24x reduction microfiche.

A study was made to assess some of the environmental impacts that might be expected to occur as the result of building a 2600 MW(t) city-wide district heating/cogeneration system in Minneapolis/St. Paul. The study focused on urban air quality impacts, power plant cooling water impacts, and disposal of solid wastes from a new cogeneration plant. Estimates were made of the SO_2 and particulate emission rates and local concentrations without and with the district heating/cogeneration system. A methodology employing fuel use data was developed to estimate emission rates from sources not included in the National Emission Data System. Predictions were made on an annual average basis and 24 h average basis for five winter days and one late summer day. With the development of the district heating/cogeneration system, the total SO_2 emission rate could decrease (up to 3%) or increase (up to 11%) depending on the retrofitted power plant load factors. In all cases there would be reductions (up to 30%) in the predicted SO_2 concentrations in the urban area due to central facilities replacing many small heating units. The particulate total emission rates and concentrations were both predicted to be slightly reduced. Changes in the trace element concentrations and deposition rates were predicted to be very small. Retrofitting existing power plants to cogeneration operation has generally positive impacts since these plants use once-through cooling. Much of the heat normally discharged into the Mississippi River would be diverted to the district heating system, thus greatly reducing the quantities of river water having temperatures above ambient. Solid wastes produced by the new cogeneration plant would be primarily ash and FGD wastes, and it is believed that they could be disposed in an environmentally safe manner.

28696 **(PB—84-153964) Enhanced recovery of coliforms by anaerobic incubation.** Sinclair, N.A. (Arizona Univ., Tucson (USA). Dept. of Microbiology). Jan 1984. 22p. NTIS, PC A02/MF A01.

A total of 529 well and distribution potable water samples were analyzed for total coliforms by the most probable number (MPN) and membrane filter (MF) techniques. Standard plate count (SPC) bacteria and MF non-coliform bacteria were also enumerated. Frequency of coliform detection, turbidity in MPN tubes and extensive overgrowth by non-coliforms on MF filters were directly proportional to SPC. Overgrowth by non-coliforms on MF filters suppressed sheen development and, in turn, masked coliform detection.

3209 Education And Public Relations

REFER ALSO TO CITATION(S) 28063

33 ADVANCED AUTOMOTIVE PROPULSION SYSTEMS

3301 Internal Combustion Engines

REFER ALSO TO CITATION(S) 28720, 28722, 28723

28697 **(AD—515005/7) Exploratory development of reduced length turbo-propulsion combustion systems. Part II. Component design and development. Technical report 1 Jan 68-30 Sep 70.** Reider, S.B.; Stettler, R.J. (General Motors Corp., Indianapolis, IN (USA). Detroit Diesel Allison Div.). Feb 1971. 176p. (DDAD-EDR—6144). NTIS, PC A09/MF A01.

Advanced design turbo-propulsion engines for future aircraft require a compact, high-performance combustion system for high thrust-to-weight ratios and an increased level of reliability. Two concepts are being incorporated to attain this goal. First, an integrated diffuser-combustor designed to achieve minimum length and maximum efficiency with smoke-free operation is being developed. Second, improved fuel injection using a high-density premix fuel injection technique to obtain acceptable combustor exit temperature patterns in a high-temperature-rise combustor is promising. Four diffuser designs were evaluated to establish length reduction techniques. Further, four premix module designs were evaluated for combustor performance values. Additionally, to complete the system design to meet the stated objectives, three liner cooling configurations were tested for system compatibility. Test data from the diffusers, premix modules, and liner cooling configurations resulted in a 60-degree sector design which attained program objectives. The technology developed on the 60-degree sector testing was used to design a scalable 120-degree sector and a full annular combustor.

Combustors incorporating integrated diffuser-combustor and fuel and air premix techniques have definite application in future aircraft turbo-propulsion engines.

28698 **(AD—865480/8) Rotating combustion engine evaluation for low noise level aircraft applications. Final report 28 Apr 69-12 Jan 70.** Berkowitz, M.; Hermes, W.L.; Lamping, H.D. (Curtiss-Wright Corp., Wood-Ridge, NJ (USA)). Jan 1970. 149p. (CW-WR—69-078.F). NTIS, PC A07/MF A01.

Performance capability of the Rotating Combustion Engine for low noise aircraft applications was investigated. The study compared the fuel-injected RC aircraft engine in both air-cooled and liquid-cooled versions with the objective of attaining low noise levels when installed in propeller-driven aircraft. Engine sizing curves indicate the expected displacement, weight and envelope size for a required horsepower rating in both liquid and air-cooled versions. These show that advanced development liquid-cooled engines can provide smaller and lighter installations compared to the air-cooled engines as a result of both better cooling capability and lower inherent noise levels as tested. Intake and exhaust mufflers as well as a noise reducing enclosure are defined and test program recommendations made. Cooling air blower requirements for the air-cooled version are defined and estimated to need no additional noise treatment.

28699 **(DOE/ET/11434—T1) Microemulsions as diesel fuels.** Friberg, S.E.; Stoffer, J.O.; Johnson, R.T. (Missouri Univ., Rolla (USA)). 15 Sep 1982. Contract FG01-78ET11434. 131p. NTIS, PC A07/MF A01; 1; GPO Dep. Order Number DE84012403.

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The basic theory of microemulsion stability is briefly reviewed. The research program on diesel fuels is presented as follows: composition of fuels, motor tests, and methods to analyze exhaust gases. (MHR)

28700 **(DOE/NASA—0266-1) Flame propagation in heterogeneous mixtures of fuel drops and air.** Myers, G.D.; Lefebvre, A.H. (Purdue Univ., Lafayette, IN (USA)). May 1984. Contract AI01-81CS50006. 54p. (NASA-CR—174644). NTIS, PC A04/MF A01; GPO Dep. Order Number DE84009884.

Photographic methods are used to measure flame speeds in flowing mixtures of fuel drops and air at atmospheric pressure. The fuels employed include a conventional fuel oil plus various blends JP 7 with stocks containing single-ring and multi-ring aromatics. The results for stoichiometric mixtures show that flame propagation cannot occur in mixtures containing mean drop sizes larger than 300 to 400 microns, depending on the fuel type. For smaller drop sizes, down to around 60 microns, flame speed is inversely proportional to drop size, indicating that evaporation rates are limiting to flame speed. Below around 60 microns, the curves of flame speed versus mean drop size flatten out, thereby demonstrating that for finely atomized sprays flame speeds are much less dependent on evaporation rates, and are governed primarily by mixing and/or chemical reaction rates. The fuels exhibiting the highest flame speeds are those containing multi-ring aromatics. This is attributed to the higher radiative heat flux emanating from their soot-bearing flames which enhances the rate of evaporation of the fuel drops approaching the flame front.

28701 **(DPST—84-231) 100 area diesel performance data.** Smith, J.A.; Tudor, A.A. (Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Lab.). 17 Jan 1984. Contract AC09-76SR00001. 18p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE84011136.

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Performance data for diesel engine-generator sets was collected to aid an analysis of the electric power system being conducted by an offsite consultant. Diesels in three different services were studied: emergency power (GM) diesels, 903 fan backup diesels and the Caterpillar diesels that power the dc motors for the D_2O pumps. It was convenient to collect data for the ECS booster pump diesel at the same time, even though it is not part of the electric power system. The results are published here to make them more widely available.

28702 **(NP—4770260) Investigation of the operating of stratified charge engines with divided combustion chamber.** Kreykenbohm, B. (Technische Hochschule Aachen (Germany, F.R.). Fakultaet fuer Maschinenwesen). 30 Mar 1981. 174p. (In German). NTIS (US Sales Only), PC A08/MF A01. Order Number DE84770260.

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A thermodynamic mathematical model for the operation process of internal combustion engines with spark ignition and stratified charge was developed and applied. Results of mathematical calculations show that the influence of mixing within the combustion chamber on the process is much greater in the case of a pre-chamber stratified charge engine than in the case of otto-engines with open combustion chamber and homogeneous mixture. Good engine tuning requires precise optimation of an exceptionally large number of operational and gemoetrical parameters. Precise influencing of combustion and mixing allow to achieve noticeable improvement of NO-emission. Mathematical investigation as described here can furnish valuable aid in searching the most promising ways of process improvement and in discussing the effects of measures taken to achieve this purpose.

28703 **(NP—4770278) Partial-load optimized Otto-engine.** Hartig, F.; Hockel, K. (Bayernwerk A.G., Muenchen (Germany, F.R.)). [nd]. 120p. (In German). NTIS (US Sales Only), PC A06/MF A01. Order Number DE84770278.

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Information gained from investigation of the lower partial-load range of a throttled Otto-engine and subsequent investigations of alternative load-control methods showed the high potential of improvement which can be achieved by reducing or evading the specific disadvantages of the conventional throttle control in the lower partial-load range. Various kinds of cylinder shut-off were investigated: from simple fuel-shut off up to the modern and more complicated methods of selective cylinder cut-off. A detailed thermodynamic analysis is given on the partial load behavior of the engine (thermal efficiency, combustion conditions in the lower partial-load range, inflammability, optimized ignition confition, driveability, influence of residual exhaust gases). A critical comparison of the different partial-load control concepts is given. As a result of the investigation, a special selective cylinder cut-off method is found. A detailed discussion of this method is given with comments on fuel consumption, pollutant emission, noise pollution, comfort and road performance selective cylinder cut-off.

28704 **(PB—84-154111) Evaluation of the IDALERT device of the Motor Vehicle Information and Cost Savings Act. Technical report.** Barth, E.A. (Environmental Protection Agency, Ann Arbor, MI (USA)). Jun 1981. 30p. (EPA-AA-TEB—511-81-6). NTIS, PC A03/MF A01.

This report announces the conclusions of the EPA evaluation of the 'IDALERTTM' device under provisions of Section 511 of the Motor Vehicle Information and Cost Savings Act. On September 19, 1980, the EPA received a request from Con-Serv, Inc. for evaluation of a fuel saving device termed 'IDALERTTM'. This device is designed to give audible and visual warnings to the vehicle operator that the vehicle engine has been idling for an excessive time period. The objective is to have the operator turn the engine off. EPA fully considered all of the information submitted by the device manufacturer in the application.

28705 **(PB—84-155316) Evaluation of the Fuel Maximiser tm: a retrofit fuel economy device. Technical report.** Penninga, T.J. (Environmental Protection Agency, Ann Arbor, MI (USA)). Nov 1981. 10p. (EPA-AA-TEB—82-2). NTIS, PC A02/MF A01.

This report announces the conclusion of EPA's evaluation of the 'Fuel Maximiser' a retrofit fuel economy device. The evaluation of the 'Fuel Maximiser' was conducted by request of the U.S. Postal service. The purpose of the evaluation was to determine if the device did perform as it was claimed. The 'Fuel Maximiser' device consists of a small coil of copper wire in a plastic enclosure which is positioned over the negative terminal of the vehicle battery. The device is allegedly creates an ion charge in the vehicle which modifies the molecular structure of the fuel, thus increasing

vehicle fuel economy. The results of the EPA testing demonstrate that the 'Fuel Maximiser' has no effect on vehicle fuel economy.

28706 **(PB—84-155936) Emissions and fuel economy of the Dresser Economizer, a retrofit device. Technical report.** Syria, S.L. (Environmental Protection Agency, Ann Arbor, MI (USA)). Dec 1981. 12p. (EPA-AA-TEB—82-3). NTIS, PC A02/MF A01.

This report describes the results of testing the Dresser Economizer as part of an evaluation under section 511 of the Motor Vehicle Information and Cost Savings Act. This device is a gasket which is installed between the intake manifold and the cylinder head. The device is claimed to improve fuel economy and driveability. The results of EPA testing show the Dresser Economizer device does not have any significant effect on regulated exhaust emissions or fuel economy.

28707 **(PB—84-163062) EPA (Environmental Protection Agency) evaluation of the V←70 Vapor Injector Device under Section 511 of the Motor Vehicle Information and Cost Savings Act.** Penninga, T.J. (Environmental Protection Agency, Ann Arbor, MI (USA)). May 1981. 84p. (EPA-AA-TEB—511-81-12). NTIS, PC A05/MF A01.

This document announces the conclusions of the EPA evaluation of the 'V-70 Vapor Injector' device under provisions of Section 511 of the Motor Vehicle Information and Cost Savings Act. The evaluation of the 'V-70 Vapor Injector' device was conducted upon the application of the manufacturer. The device is basically a controlled air bleed device where the air is bubbled through a mixture of water and an additive supplied by the Applicant. The Applicant submitted insufficient test data to prove that the 'V-70 Vapor Injector' device would improve fuel economy. EPA testing of similar devices failed to show a fuel economy benefit.

28708 **Performance evaluation of 10% ethanol-gasoline blends in 1980 model year U.S. cars.** Bernstein, L.S.; Brinkman, N.D.; Carlson, R.R. (Exxon Research & Engineering Co.). *SAE (Society of Automotive Engineers) Special Publication;* SP-527: 1-17(Oct 1982). Contract AC03-79CS50003.

The Coordinating Research Council, Inc. (CRC), under contract to the U.S. Department of Energy, conducted controlled tests to determine the effects of 10% ethanol-gasoline blends on emissions, fuel economy, and driveability of 14 - 1980 model year cars representing several emission-control technologies. Two types of ethanol blends were tested, a simple blend with no volatility adjustment, and two volatility adjusted blends. Addition of 10% ethanol to gasoline resulted in statistically significant changes in emissions, driveability, and efficiency. Statistically significant effects were also found as a result of volatility adjustment. However, because of the limited fleet size, these results should not be used to quantitatively predict effects of the use of ethanol-gasoline blends in the total U.S. vehicle population.

28709 **A modern alternative to oil-fired ships.** Botts, T.E.; Powell, J.D.; Powell, J.R. (Brookhaven National Laboratory Upton, New York). *Alternative Energy Sources;* 6: 333-338(Dec 1980). (CONF-801210—).

From 3. Miami international conference on alternative energy sources; Miami Beach, FL, USA (15 Dec 1980).

A direct coal-fired turbine is a very light engine for powering ships. Weight savings over a diesel engine nearly make up for the added weight associated with fuel bunkering when converting from oil to coal-firing. A method of hot-gas-particulate cleanup based on packed and fluidized rotating beds of Al_2O_3 is discussed as a means of providing adequate turbine blade lifetime. Two cases, a cargo ship and large merchant tanker are considered. Present value of fuel savings equates to the value of a coal-fired turbine. For a tenyear lifetime, the velue of the turbine due to fuel-lost savings is projected to be roughly 48 M$ for the cargo ship and 194 M$ for the tanker.

3302 External Combustion Engines

28710 **(DOE/NASA—1005-2) Overview of NASA Lewis Research Center free-piston Stirling engine activities.** Slaby, J.G. (National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center). 1984. Contract AI05-82OR21005. 20p. (NASA-TM—83649; CONF-840804—3). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE84010761.

From Intersociety energy conversion engineering conference; San Francisco, CA, USA (19 Aug 1984).

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An overview of the National Aeronautics and Space Administration (NASA) Lewis Research Center (LeRC) free-piston Stirling engine activities is presented. These include (1) a generic free-piston Stirling technology project being conducted to develop technologies generic to both space power and terrestrial heat pump applications in a cooperative, cost-shared effort with the Department of Energy (DOE)/Oak Ridge National Laboratory (ORNL); and (2) a free-piston Stirling space power technology feasibility demonstration project being conducted in support of the Defense Advanced Research Projects Agency (DARPA), DOE, NASA, SP-100 project. The generic technology effort includes extensive parametric testing of a 1 kW free-piston Stirling engine (RE-1000), development of a free-piston Stirling performance computer code, design and fabrication under contract of a hydraulic output modification for RE-1000 engine tests, and a 1000-hour endurance test, under contract, of a 3 kWe free-piston Stirling/alternator engine. The newly initiated space power technology feasibility demonstration effort addresses the capability of scaling a free-piston Stirling/alternator system to about 25 kWe; developing thermodynamic cycle efficiency ≧ 70 percent of Carnot at temperature ratios in the order of 1.5 to 2.0; achieving a power conversion unit specific weight of 6 kg/kWe; operating with noncontacting gas bearings; and dynamically balancing the system. Planned engine and component design and test efforts are described.

3303 Electric-powered Systems

REFER ALSO TO CITATION(S) 28486

28711 **(CONF-830201—4) Electric vehicle operations in a cold climate.** (Oak Ridge National Lab., TN (USA)). 1983. Contract AC05-84OR21400. 6p. NTIS, PC A02; 3; GPO Dep. Order Number DE84011706.

From Society of Automotive Engineers congress; Detroit, MI, USA (28 Feb 1983).

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Ten electric vehicles began service at two locations in Wisconsin at the start of 1983. These vehicles are fiberglass-body and lighter than other electrically-powered passenger cars available. Initial experience shows a substantially lower fuel use as well as higher range than the average EV in the test program sponsored by U.S. Department of Energy. Specific component problems have occurred (e.g., auxiliary battery charge) and are documented, along with the overall record of vehicle operation, including range and energy use.

28712 **(CONF-840608—1) Operation of electric vehicles in the US Department of Energy Test Program.** Friedman, K.; LaBelle, S.J. (USDOE Assistant Secretary for Conservation and Solar Energy, Washington, DC. Office of Electric and Hybrid Vehicles; Argonne National Lab., IL (USA)). 1984. Contract W-31-109-ENG-38. 7p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE84011703.

From 7. international symposium on the electric road vehicle; Versailles, France (26 Jun 1984).

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Over 700 electric vehicles have been in operation at more than 70 US sites since 1981. Data are collected on their operation. Analyses of these data indicate that the energy use of electric vehicles varies with temperature, age of battery, driver behavior, terrain, vehicle operating speed and charging method, as well as with

vehicle characteristics such as weight. Appropriate missions for electric vehicles have been identified, and many improvements to vehicle and component design suggested as a result of this program. Highlights of component tests now underway are described, as well as field tests of batteries.

28713 **(DOE/NV/10032—1) Electric and hybrid vehicle demonstration project. Final report.** (Kansas City, City of, MO (USA). Public Works Dept.). Nov 1983. Contract FC08-79NV10032. 3p. NTIS, PC A02/MF A01; GPO Dep. Order Number DE84011388.

This is the Kansas City, Missouri final report concerning the Electric and Hybrid Vehicle Demonstration Project. Subjects covered address the scope of the project, overall evaluation and perspective, major advantages and opportunities, major difficulties and resolutions, summary of data and results, and participant's recommendations and assessments.

28714 **(TVA/OP/EDT—84/21) Electric vehicle battery system testing at TVA.** Barnett, J.H.; Blickwedel, T.W. (Tennessee Valley Authority, Chattanooga (USA). Div. of Energy Demonstrations and Technology). 1984. 13p. NTIS, PC A02. Order Number DE84901085.

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It was found that lead-acid batteries, because of low specific energy density and life, are marginal for eV use. However, with the established lead-acid industry, they may be more economical for limited future eV applications. The NiFe battery provides sufficient energy density and range for many eV applications and can withstand abusive treatment. With its longer life, this system is attractive for commercial eV applications. It is also anticipated that NiZn, NiCd, and ZnCl systems may also show promise for the future.

28715 **(TVA/OP/EDT—84/22) Test and evaluation report for the USPS Comuta Van.** Driggans, R.L.; Whitehead, G.D.; Buffett, R.K. (Tennessee Valley Authority, Chattanooga (USA). Div. of Energy Demonstrations and Technology). Mar 1984. 89p. NTIS, PC A05/MF A01. Order Number DE84901087.

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A Comuta Van produced by Commuter Vehicles, Inc., for the United States Postal Service was performance-tested by the Tennessee Valley Authority at its Electric Vehicle Test Facility. The Comuta Van was tested for acceleration, top speed, gradability, and driving range under both constant speed and stop/start operation. This report presents test results, data on vehicle operating conditions, descriptions of the vehicle and components, and information on vehicle reliability during the test peiod.

28716 **(TVA/OP/EDT—84/25) Test and evaluation of the Philips Model PE 1701 and Lester Model 9865 electric vehicle battery chargers.** Reese, R.W.; Driggans, R.L.; Keller, A.S. (Tennessee Valley Authority, Chattanooga (USA). Div. of Energy Demonstrations and Technology). Apr 1984. 80p. NTIS, PC A05/MF A01. Order Number DE84901243.

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The Philips Model PE 1701 and the Lester Model 9865 electric vehicle battery chargers have been tested by the Tennessee Valley Authority. Charger input/output voltage, current, power characteristics, and input waveform distortion were measured and induced electromagnetic interference was evaluated while the chargers recharged a fully discharged lead-acid battery pack. Electrical quantities were measured with precision volt-ampere-watt meters, frequency counters, a digital storage oscilloscope, and a spectrum analyzer. The Philips charger required 12.2 hours to recharge a 144-V battery; it had an energy efficiency of 86.0 percent and a specific power of 87.4 W/kg (39.7 W/lb). Input current distortion was between 6.9 and 23.0 percent, and electromagnetic interference was observed on AM radio. The Lester charger required 8.2 hours to recharge a 106-V battery; it had an energy efficiency of 83.0 percent and a specific power of 117.3 W/kg (53.3 W/lb). Current distortion was between 52.7 and 97.4 percent, and electromagnetic interference was observed on AM radio.

3304 Hybrid Systems

REFER ALSO TO CITATION(S) 28713

3305 Flywheel Propulsion

28717 **Composite material flywheel for the electric-powered passenger vehicle.** Towgood, D.A.; Satchwell, D.L. (AiResearch Manufacturing Co. of California, Torrance). *Science of Advanced Materials and Process Engineering Proceedings;* **23**: 703-711(1978). (CONF-780502—).

From 23. national SAMPE symposium; Anaheim, CA, USA (2 May 1978).

AiResearch has successfully operated a 23-in.-diameter, Kevlar-reinforced, epoxy flywheel in a design evaluation test for the Department of Energy electric-powered passenger vehicle. This composite material flywheel was subjected to 1000 deep acceleration-deceleration cycles of 12,500 to 25,000 rpm for two weeks. These accelerated life cycles represent an expected vehicle life of 10 years. The multiring flywheel is rim-mounted on a four-spoke aluminum hub. The rim comprises a set of nested, S-2 fiberglass epoxy rings reinforced with Kevlar 29 and Kevlar 49. Candidate materials considered for this design will be compared in terms of mechanical properties and relative material costs per unit of stored energy.

3307 Emission Control

28718 **(PB—84-154194) EPA (Environmental Protection Agency) evaluation of the optimizer device under Section 511 of the Motor Vehicle Information and Cost Savings Act.** Barth, E.A. (Environmental Protection Agency, Ann Arbor, MI (USA)). May 1983. 124p. (EPA-AA-TEB—511-83-9). NTIS, PC A06/MF A01.

This report announces the conclusions of the EPA evaluation of the Optimizer device under the provisions of section 511 of the Motor Vehicle Information and Cost Savings Act. The evaluation of the Optimizer was conducted upon the application of the manufacturer. The basic device is a combustion catalyst consisting of an electric fuel heater containing a bed of platinum deposited on an inert substrate. The remainder of the system includes a heater relay, a condenser to cool the fuel to operating temperature, and the associated plumbing. According to the applicant, the device introduces a very small amount of platinum into the fuel. This enhances the combustion process and allows ignition timing to be advanced. The device, coupled with the ignition timing adjustments, is claimed to improve fuel economy, increase performance, and reduce engine maintenance while keeping emissions low. EPA fully considered all of the information submitted by the applicant. The evaluation of the Optimizer device was based on that information and EPA's engineering judgement. The overall conclusion is that, for most vehicles, the device and the prescribed ignition timing adjustments of the engine will cause a small improvement in fuel economy and a large increase in NOx (oxides of nitrogen) emissions.

28719 **(PB—84-155712) Evaluation of the temperature effects on five 1981 passenger vehicles. Technical report.** Branham, R.J. (Environmental Protection Agency, Ann Arbor, MI (USA)). Dec 1981. 20p. (EPA-AA-TEB—82-4). NTIS, PC A02/MF A01.

This report summarizes the results of a study done to evaluate how 1981 model year motor vehicle emission systems react to ambient temperatures. Five different vehicles with mileages between 500 and 700 miles were tested using the EPA Cold Environmental Test Cell (CETC). Each vehicle was tested according to the Federal Test Procedure (FTP) and the Highway Fuel Economy Test (HFET) at ambient temperatures of 20, 60, 75, and 100 degrees F. The results show that the lower the ambient temperature is, the higher the emission levels for city driving are. In addition, ambient temperatures do not affect exhaust emission levels drastically for highway driving.

3308 Alternative Fuels

REFER ALSO TO CITATION(S) 28699, 28708

28720 (DOE/CE/50036—T2) Research and development of alcohol fuel usage in spark ignited engines. Monthly progress report, April 1984. (Santa Clara Univ., CA (USA)). Apr 1984. Contract FG03-84CE50036. 8p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE84011177.

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Progress is reported on the following: cold start studies, computer modeling of cold starting, cold star droplet preparation studies, corrosion and wear study, smog chamber experiments, Toyota Cressida, and the CVS data reduction program upgrade. (MHR)

28721 Performance evaluation of ethanol-gasoline blend in late model U.S. vehicles. Carlson, R.R. (Systems Control, Inc., Anaheim, CA); Bernstein, L.S.; Ecklund, E.E. pp 2/14-2/21 of Proceedings Fifth International Alcohol Fuel Technology Symposium--Volume II. Dunedin, New Zealand; John McIndoe Limited (1982). (CONF-8205227—Vol.2). Contract AC03-79CS50003.

From 5. international alcohol fuel technology symposium; Auckland, New Zealand (13 May 1982).

Emissions, fuel economy, and driveability of 14-1980 model year, U.S. vehicles were measured on a base gasoline and three 10% ethanol-gasoline blends. Seven of the vehicles had open-loop emission control systems and were designed to meet Federal emission standards, the other seven had closed-loop emission control systems and were designed to meet California emission standards. The three 10% ethanol fuels had varying degrees of volatility adjustment. The first was simply a mixture of gasoline and 10% ethanol. In the second, the hydrocarbon fraction was adjusted such that the Reid Vapor Pressure (RVP) of the final blend matched that of the base gasoline. In the third, the hydrocarbon fraction was adjusted such that both RVP and % evaporated at 70°C (158°F) of the final blend matched that of the base gasoline. Use of the ethanol-containing fuels resulted in statistically significant changes in emissions, fuel economy and driveability. Differences in the response of open and closed-loop vehicles and in the response to the changes in composition of the three ethanol-containing fuels were also found.

28722 Results from ethanol fumigation of an I.D.I. and a D.I. diesel engine. Foster, D.E. (Univ. of Wisconsin-Madison); Myers, P.S.; Lestz, S.S.; Fleming, R.D.; Ecklund, E.E. pp 2/262-2/271 of Proceedings Fifth International Alcohol Fuel Technology Symposium--Volume II. Dunedin, New Zealand; John McIndoe Limited (1982). (CONF-8205227—Vol.2).

From 5. international alcohol fuel technology symposium; Auckland, New Zealand (13 May 1982).

Experiments were run in which 200 proof ethanol was fumigated into two diesel engines. One was a four cylinder, four stroke, direct injection, turbocharged diesel and the other was an eight cylinder, four-stroke indirect injection, naturally aspirated diesel. Both engines operated in the load range of 205° kPa (BMEP) to 758 kPa (BMEP) so a comparison between the two engines operating on alcohol could be made as well as an overall evaluation of engine operation with fumigation. The overall performance and emission trends were measured.

28723 Evaluation of stabilized alcohol/petroleum fuels in a direct injection diesel engine. Johnson, R.T. (Univ. of Missouri-Rolla); Friberg, S.; Stoffer, J.O.; Fleming, R.D.; Ecklund, E.E. pp 2/293-2/300 of Proceedings Fifth International Alcohol Fuel Technology Symposium--Volume II. Dunedin, New Zealand; John McIndoe Limited (1982). (CONF-8205227—Vol.2). Contract AC02-79CS50026.

From 5. international alcohol fuel technology symposium; Auckland, New Zealand (13 May 1982).

Results from a project to evaluate stabilized diesel fuels containing alcohols, stabilizers, and contamination level water are reported. Through formulation and fuel properties evaluation programs, six fuel systems, comprised of 15 different fuels, were developed for evaluation as diesel engine fuels. These fuels contained alcohol (methanol or ethanol) with contaminant water and chemical stabilizer in three different base fuels of low, medium, and high aromatic content. All fuels were tested in a single cylinder engine at equal energy input rates. Except for some increases in HC emissions, all fuels had similar gaseous emissions, power, and efficiency. The fuels containing low molecular weight alcohols showed substantial reductions in both visible smoke and mass particulate emissions. The amount and character of the soluble organic fraction of the particulate emissions were also affected by the low molecular weight alcohols. The soluble fraction increased, primarily in lower molecular weight species. The mass soluble fraction per joule of energy produced was essentially unchanged due to the reduced particulate mass for the alcohol fuel systems.

36 MATERIALS

REFER ALSO TO CITATION(S) 28163

3601 Metals And Alloys

REFER ALSO TO CITATION(S) 27716, 27921, 27921, 27950, 27950, 28239, 28266, 28267, 28267, 28279, 28282, 28286, 28286, 28290, 28314, 28316, 28320, 28323, 28324, 28325, 28326, 28327, 28403, 29995, 30005

28724 (BNL—34691) Dynamics of itinerant ferromagnets above T/sub c/. Shirane, G.; Boeni, P.; Wicksted, J. (Brookhaven National Lab., Upton, NY (USA)). Apr 1984. Contract AC02-76CH00016. 19p. (CONF-8403122—1). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE84011910.

From 4. general CMD conference of the condensed matter division of the European Physical Society; Hague, Netherlands (19 Mar 1984).

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The existence of propagating spin waves above T/sub c/ in Ni and Fe has been widely accepted since this picture was first advocated in 1973. In this brief review of our current neutron scattering experiments on Fe and Ni we will present convincing evidence showing that this picture is incorrect. In addition, we will demonstrate that over wide ranges of ω, q and temperature, both Fe and Ni follow a simple paramagnetic scattering function of the spin diffusion type. 19 references.

28725 (CEA-CONF—6827) Fast neutron irradiation of alloys with a higher nickel content than SS 316. Carteret, Y.; Maillard, A.; Aubert, H. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France)). Mar 1983. 17p. (In French). (CONF-8303120—1). NTIS (US Sales Only), PC A02/MF A01. Order Number DE84750672.

From Meeting on new cladding materials.; Moscow, USSR (9 Mar 1983).

Previous tests have shown the importance of nickel in the swelling of iron-nickel-chromium alloys. Results of irradiation by fast neutrons of alloy richer in nickel than stainless steels are reported. Main conclusions are: hardened austenitic steels with a Ni content of 20 and 25% are not better than 316 because of high deformation for low stress; swelling and creep irradiation are lower than for 316 (Ti) in alloys NIM PE 16, INC 706 or INC 625 irradiated under 500°C and 75 dpa F; with Inconel 706 ductility still good at room temperature or at 450°C is very low at 600°C.

28726 (CEA-CONF—6846) Relationship between the electronic structure and the glide in the hexagonal close packed metals. Legrand, B.; Le Hazif, R. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France)). Jun 1983. 5p. (CONF-830680—3). NTIS (US Sales Only), PC A02/MF A01. Order Number DE84750641.

From International symposium on the structure and properties of crystal defects; Liblice, Czechoslovakia (13 Jun 1983).

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In all hexagonal close-packed metals (HCP), deformation is performed by slip on a mean glide system (MGS) and on several secondary systems. There are no reliable predictions of the MGS choice. In this paper is shown the role played by the electronic

structure on the choice of glide system in HCP metals. MGS is basal for all normal metals and is a function of the electron number in HCP transition metals. The different SFE's were calculated using appropriate total energy models, for different metals. Thus pseudopotentials were used (or empirical pair potentials) for normal metals, and a tight-binding model for transition metals. The most important results are the following: prismatic SFE (PSFE) is smaller than basal SFE (BSFE) for Y, Ti, Zr, Hf, Ru and Os; BSFE is smaller than PSFE for Co and all normal metals; BSFE and PSFe and about the same for RE and Tc.

28727 **(CEA-CONF—6876) Theoretical equation of state for uranium.** Penicaud, M. (CEA Centre d'Etudes de Limeil, 94 - Villeneuve-Saint-Georges (France)). Jul 1983. 4p. (CONF-830719—59). NTIS (US Sales Only), PC A02/MF A01. Order Number DE84750621.

From American Physical Society meeting on shock waves in condensed media; Santa Fe, NM, USA (18 Jul 1983).

We use a fully relativistic generalization of the self-consistent muffin-tin-orbital (MTO) method to obtain the electronic properties of uranium at pressures up to 5 Mbar. 6 s and 6 p1/2, 6 p3/2 states are treated as bands rather than core states which is found necessary. The derived equation of state agrees well with shock Hugoniot data.

28728 **(CEA-CONF—6892) Structural study of the liquid germanium by means of thermal neutron scattering.** Bellissent-Funel, M.C.; Bellissent, R. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France)). Aug 1983. 6p. (CONF-830888—13). NTIS (US Sales Only), PC A02/MF A01. Order Number DE84750622.

From 5. international conference on liquid and amorphous metals; Los Angeles, CA, USA (15 Aug 1983).

We have performed a very precise measurement of the structure factor of liquid germanium at 1223K and 1473K using a 640-cell position sensitive detector. The coordination number is found to be nearly insensitive to the temperature. On the other hand, the obtained structure factors are compared with those deduced from both quasicrystalline and hard sphere type models in order to explain the strong change of the coordination number of the germanium at the melting point.

28729 **(CEA-CONF—6924) Contribution of scanning Auger microscopy to electron beam damage study.** Fontaine, J.M. (CEA Centre d'Etudes de Bruyeres-le-Chatel, 92 - Montrouge (France)). Apr 1983. 52p. (CONF-8304151—1). NTIS (US Sales Only), PC A02/MF A01. Order Number DE84750647.

From Scanning electron microscopy conference; Dearborn, MI, USA (17 Apr 1983).

Electron bombardment can produce surface modifications of the analysed sample. The electron beam effects on solid surfaces which have been discussed in the published literature can be classified into the following four categories: (1) heating and its consequent effects, (2) charge accumulation in insulators and its consequent effects, (3) electron stimulated adsorption (ESA), and (4) electron stimulated desorption and/or decomposition (ESD). In order to understand the physico-chemical processes which take place under electron irradiation in an Al-O system, we have carried out experiments in which, effects, such as heating, charging and gas contamination, were absent. Our results point out the role of an enhanced surface diffusion of oxygen during electron bombardment of an Al (111) sample. The importance of this phenomenon and the contribution of near-elastic scattering of the primary electrons (5 keV) to the increase of the oxidation degree observed on Al (111) are discussed, compared to the generally studied effects.

28730 **(CEA-CONF—6955) Preparation of thin layer deposits of actinides for studies in nuclear physics and solid state physics.** Kwinta, J.; Brossard, P.; Michel, J.J.; Thoreux, J. (CEA Centre d'Etudes de Bruyeres-le-Chatel, 92 - Montrouge (France)). Sep 1983. 3p. (In French). (CONF-8309124—4). NTIS (US Sales Only), PC A02/MF A01. Order Number DE84750640.

From 1. international conference on the chemistry and technology of the lanthanides and actinides; Venice, Italy (5 Sep 1983).

Two methods of deposition are described electrospraying and spraying with a ion beam. In the first method a solution is send through a capillary containing an electrode at a positive potential in respect to the support of the coating. In the second method ions (generally rare gases) produced by a source are accelerated and focussed with an electrostatic lens on the material to pulverize. Both are complementary to classical methods like electrodeposition and vacuum vaporization which are difficult to use in the case of rare isotopes.

28731 **(CEA-CONF—7006) Defects induced by annealing or irradiation in CZ silicon or germanium.** Desseaux-Thibault, J.; Bourret, A.; Penisson, J.M. (CEA Centre d'Etudes Nucleaires de Grenoble, 38 (France)). Mar 1983. 6p. (CONF-8303121—1). NTIS (US Sales Only), PC A02/MF A01. Order Number DE84750673.

From Microscopy of semiconducting materials meeting; Oxford, UK (21 Mar 1983).

A comparison is made between defects obtained by annealing and irradiation. The defects are observed by high resolution electron microscopy. Irradiation induced <110> line defects obtained with 1 MeV electrons are easy to obtain in germanium. They look similar to rod-like defects in Si produced after a long-anneal at 650°C. Black-dots obtained in both treatments are compared with the defects produced during ion bombardment in Si.

28732 **(CEA-CONF—7013) Internal friction of magnesium from 0.8K; effect of electron irradiation.** Minier, C.; Lauzier, J.; Disdier, F.; Lagnier, R. (Grenoble-1 Univ., 38 (France); CEA Centre d'Etudes Nucleaires de Grenoble, 38 (France)). Jul 1983. 6p. (In French). (CONF-8307115—1). NTIS (US Sales Only), PC A02/MF A01. Order Number DE84750676.

From 4. European conference on internal friction and ultrasonic attenuation in solids; Villeurbanne, France (5 Jul 1983).

A new irradiation facility with internal friction and modulus measurements beginning at 0,7 K is described. Preliminary results on magnesium are presented.

28733 **(CONF-830719—60) Mechanical properties of a shock consolidated steel powder.** Kasiraj, P.; Vreeland, T. Jr.: Schwarz, R.B.; Ahrens, T.J. (California Inst. of Tech., Pasadena (USA); Argonne National Lab., IL (USA)). Sep 1983. Contract W-31-109-ENG-38. 5p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE84003573.

From American Physical Society meeting on shock waves in condensed media; Santa Fe, NM, USA (18 Jul 1983).

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The microhardness, ultimate tensile strength, and elastic modulus of 44 to 74 μm AISI 9310 rapidly solidified powder, consolidated by shock waves with energies varying from 94 to 770 kJ/kg and a shock duration of 2 to 3 μs, are presented. The compacts produced have a variation in diamond pyramid hardness from 390 to 510, in strength from 0 to 1.4 GPa, and in elastic modulus from 66 to 181 GPa. The hardness and strength reach a maximum at 500 kJ/kg shock energy. The strength and elastic modulus results imply that 800 kJ/kg shock energy produces complete interparticle bonding.

28734 **(CONF-830942—48) Ion bombardment effects on the fatigue life of stainless steel under simulated fusion first wall conditions.** Kohse, G.; Harling, O.K. (Massachusetts Inst. of Tech., Cambridge (USA). Nuclear Reactor Lab.). 1983. Contract AC02-78ET52027. 5p. NTIS, PC A02/MF A01; GPO Dep. Order Number DE84001300.

From 3. topical meeting on fusion reactor materials; Albuquerque, NM, USA (19 Sep 1983).

Pressurized tube specimens have been exposed to simultaneous multi-energy surface ion bombardment, fast neutron irradiation and stress and temperature cycling, in a simulation of a possible fusion reactor first wall environment. After ion bombardments equivalent to months-years of reactor operation and up to 30,000 cycles, no detrimental effects on post-irradiation fatigue life were found. The ion damage is found to enhance surface cracking, but this effect is limited to the several micron surface layer in which the ions are implanted.

28735 (CONF-840411—20) **Perspective of the corrosive behavior of lithium and sodium.** DeVan, J.H.; Bagnall, C. (Oak Ridge National Lab., TN (USA); Westinghouse Electric Corp., Pittsburgh, PA (USA)). 19 Apr 1984. Contract AC05-84OR21400. 8p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE84011635.

From 3. meeting on liquid metal in energy applications; Oxford, UK (9 Apr 1984).

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Although the corrosion properties of sodium have been studied extensively between 500 and 650°C, the corrosion information available for lithium at these temperatures is still fragmentary, and the understanding of corrosion processes is far behind that for sodium. A review of the available corrosion data shows striking similarities in the overall mass transfer processes for lithium and sodium in austenitic stainless steel systems. Preferential depletion of nickel and chromium leads to the development of a ferrite surface layer and a constant corrosion rate with time. However, the corrosion processes also show basic differences in terms of the microscopic appearance of the ferrite surface layer and the effects of oxygen and nitrogen impurities. This report reviews these similarities and differences in the context of corrosion mechanisms and kinetics that operate under dynamic flow conditions.

28736 (CONF-8308130—, pp 86-97) **Review of tantalum and niobium alloy production.** Buckman, R.W. Jr. 1984. NTIS, PC A13/MF A01. Order Number DE84001745. TI84001745

From Symposium on refractory alloy technology for space nuclear power applications; Oak Ridge, TN, USA (10 Aug 1983).

This paper concentrates on the current state of niobium- and tantalum-base alloy production. The materials requirements, alloy compositions of interest, and production status are discussed. Finally, a list of developments needed to support the SP-100 program will be identified. A bibliography is included.

28737 (CONF-8308130—, pp 98-113) **Processing and production of molybdenum and tungsten alloys.** Hagel, W.C.; Shields, J.A. Jr.; Tuominen, S.M. 1984. NTIS, PC A13/MF A01. Order Number DE84001745. TI84001745

From Symposium on refractory alloy technology for space nuclear power applications; Oak Ridge, TN, USA (10 Aug 1983).

The technological means to produce and process Mo and W alloys are summarized because for many Mo and W alloy systems the mechanical properties can be optimized only by thermomechanical processing requiring production and processing capabilities that are not widely available. First, the producers of commercial Mo and W alloys are presented along with currently available product forms. Second, currently disclosed standard capabilities of producers and processors in the United States are presented. 56 references, 13 figures, 9 tables.

28738 (CONF-8308130—, pp 114-129) **CVD refractory metals and alloys for space nuclear power application.** Yang, L.; Gulden, T.D.; Watson, J.F. 1984. NTIS, PC A13/MF A01. Order Number DE84001745. TI84001745

From Symposium on refractory alloy technology for space nuclear power applications; Oak Ridge, TN, USA (10 Aug 1983).

CVD technology has made significant contributions to the development of space nuclear power systems during the period 1962 to 1972. For the in-core thermionic concept, CVD technology is essential to the fabrication of the tungsten electron emitter. For the liquid metal cooled fuel pin using uranium nitride as fuel and T-111 and Nb-1 Zr as cladding, a tungsten barrier possibly produced by CVD methods is essential to the fuel-cladding compatibility at the designed operating temperature. Space power reactors may use heat pipes to transfer heat from the reactor core to the conversion system. CVD technology has been used for fabricating the heat pipe used as cross-flow heat exchanger, including the built-in channels on the condenser wall for liquid lithium return. 28 references, 17 figures.

28739 (CONF-8308130—, pp 130-145) **Machining refractory alloys: an overview.** Christopher, J.D. 1984. NTIS, PC A13/MF A01. Order Number DE84001745. TI84001745

From Symposium on refractory alloy technology for space nuclear power applications; Oak Ridge, TN, USA (10 Aug 1983).

Nontraditional machining is a generic term for those material removal processes that differ drastically from the historic operations such as turning, milling, drilling, tapping, and grinding. The use of primary energy modes other than mechanical, such as thermal, electrical, and chemical, sets these operations apart and reinforces their nontraditional label. Several of these newer processes have been very successful in machining close tolerance parts from refractory materials. This paper provides a general overview of both traditional and nontraditional aspects of machining refractory materials. 11 figures, 7 tables.

28740 (CONF-8308130—, pp 146-167) **Welding of refractory alloys.** Lessmann, G.G. 1984. NTIS, PC A13/MF A01. Order Number DE84001745. TI84001745

From Symposium on refractory alloy technology for space nuclear power applications; Oak Ridge, TN, USA (10 Aug 1983).

This review primarily summarizes welding evaluations supported by NASA-Lewis Research Center in the 1960s. A literature search run in preparation for this review indicates that more recent work is modest by comparison. Hence, this review restates these accomplishments briefly and addresses opportunities which have evolved in welding technology (such as lasers) in the intervening decade. Emphasis in this review is given to tantalum- and niobium-base alloys. Considerable work was also done to assure that a consistent comparison was made with tungsten. A wide variety of candidate alloys derived primarily from developments directed at aircraft propulsion applications were available. Early efforts by NASA were directed at screening studies to select promising structural alloys for the space power application. This objective required fine tuning of welding procedures, e.g., the demonstration of stringent standards for control of welding atmosphere to assure good corrosion resistance in liquid alkali metals. 16 figures, 6 tables.

28741 (CONF-8308130—, pp 227-251) **Mechanical and physical properties of refractory metals and alloys.** Conway, J.B. 1984. NTIS, PC A13/MF A01. Order Number DE84001745. TI84001745

From Symposium on refractory alloy technology for space nuclear power applications; Oak Ridge, TN, USA (10 Aug 1983).

This paper provides some discussion of the technology of refractory metals and alloys for application to space nuclear power. This paper was designed to focus on the mechanical and physical properties of this group of materials with the intent of identifying the status of existing information. Another objective of this paper was to make some assessment of the existing property information and then to determine those measurements that must be made in order to serve the needs of the space nuclear power programs. The review portion of this paper focuses on the following properties: thermal expansion; thermal conductivity; enthalpy and heat capacity; tensile strength; stress rupture and creep strength; and fatigue strength. 62 references, 25 figures.

28742 (CONF-8308130—, pp 252-277) **Effects of irradiation on properties of refractory alloys with emphasis on space power reactor applications.** Wiffen, F.W. 1984. NTIS, PC A13/MF A01. Order Number DE84001745. TI84001745

From Symposium on refractory alloy technology for space nuclear power applications; Oak Ridge, TN, USA (10 Aug 1983).

The probable effects of irradiation on niobium and tungsten alloys in use as components of thermionic convertors in a space reactor were reviewed by the author in 1971. While considerably more data on refractory metals have been generated since that time, the data have not been reviewed with respect to space reactor applications. This paper attempts such a review. The approach used is to work from the most recently available review of irradiation effects for each alloy system (where such a review is available) and to discuss that review and more recent data judged to be the most useful in establishing likely behavior in high-temperature reactor service. 28 figures, 6 tables.

28743 (CONF-8404141—3) **Small-angle neutron scattering study of the decomposition of Fe-28Cr-10.5Co.** Spooner, S. (Oak Ridge National Lab., TN (USA)). 1984. Contract AC05-84OR21400. 4p. NTIS, PC A02/MF A01; GPO Dep. Order Number DE84011665.

From International topical conference on kinetics of aggregation and gelation; Atlanta, GA, USA (2 Apr 1984).

Dynamic scaling of the decomposition of an Fe-28Cr-10.5Co alloy treated at 450°, 500°, and 550°C after a water quench from 950°C was investigated with small-angle neutron scattering. Scattering curves measured from the alloy treated at 500°C and 550°C for times up to 100 hours can be superimposed on a common curve usiu.ʒ a k/sub m/$^{-1}$-scaling of the scattering vector length ($k = 4\pi\sin(\theta)/\lambda$) and k^3/sub m/-scaling of the scattering intensity scale, where k/sub m/ is the scattering vector for maximum intensity for each scattering curve. At 450°C, however, such dynamic scaling does not apply for treatment times between 32 and 192 hours. The 450°C curve for 256 hours does scale to the common curve for treatments at 500°C and 550°C. The departure from scaling found at 450°C is consistent with the absence of sharp interfaces and the persistence of localized clustering or critical scattering in the chromium-rich and iron-rich regions. An analysis of the shape of the scattering curves was made in terms of a cluster interference function. It was found that a Gaussian single cluster function is modulated by a cluster interference function given by (k/k*)/sup n/ exponent n is approximately 4 and k* is the limit in k beyond which the interference function is unity. This exponent is larger than that found in computer simulations and in experimental studies of spinodal systems.

28744 **(CONF-8404141—4) Atom probe: a direct technique for kinetic measurements.** Miller, M.K.; Brenner, S.S.; Camus, P.P.; Soffa, W.A. (Oak Ridge National Lab., TN (USA); Pittsburgh Univ., PA (USA)). 4 Apr 1984. Contract AC05-84OR21400. 4p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE84011669.

From International topical conference on kinetics of aggregation and gelation; Atlanta, GA, USA (2 Apr 1984).

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The atom probe has been used to study the phase transformations occurring within the low-temperature miscibility gaps in Fe-Cr and Fe-Cr-Co alloys. The morphology of the two-phase microstructure resulting from phase separation deep within the miscibility gaps was found to be highly interconnected and charactristic of an isotropic spinodal reaction. The characteristic dimensions of the microstructure and the changes in composition were measured as a function of aging. The coarsening of the network structures could be fitted with a power law with time exponents that were significantly less than the classical Lifshitz-Slyozov-Wagner value of one-third.

28745 **(CTOM—49178) Passivation breakdown of nickel and Zircaloy-4 in alkaline chloride solutions at 20 to 300°C.** Ling, R.H.M. (Saskatchewan Univ., Saskatoon (Canada)). 1981. 295p. Canadian Theses on Microfiche Service, National Library of Canada, Ottawa, Canada K1A 0N4.

Passivation breakdown or pitting corrosion of transition metals and their alloys in chloride solutions was studied with particular reference to iron, nickel, zirconium and their alloys at elevated temperatures. The effects of flow on pitting corrosion and implications for the design of industrial systems were also reviewed. High temperature and pressure electrochemical pitting was studied under controlled hydrodynamic conditions in a nickel flow loop. Potentiokinetic studies of the passivation breakdown and repassivation potentials for nickel-200 and Zircaloy-4 in borate-buffered and unbuffered alkaline chloride solutions were carried out between 20 and 300°C. It was found that the potentials for nickel moved to more active values with an increase in the temperature until a temperature was reached at which the trend was reversed, indicating greater resistance to pitting at higher temperatures. This phenomenon was also found in zirconium alloys. Two theories, one based on the defect structure of oxides and the other on the variation of oxide thickness with temperature, are suggested to explain the temperature dependence of passivation breakdown and repassivation potentials.

28746 **(DOE/ER—0046/15) Damage analysis and fundamental studies. Quarterly progress report, July-September 1983.** (Hanford Engineering Development Lab., Richland, WA (USA); USDOE Office of Energy Research, Washington, DC. Office of Fusion Energy). Nov 1983. Contract AC06-76FF02170. 144p. NTIS, PC A07/MF A01; 1; GPO Dep. Order Number DE84009143.

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Separate abstracts were prepared for 17 of the included sections. (MOW)

28747 (DOE/ER—0046/15, pp 12-16) **Comparison of measured and calculated helium production in nickel for fission reactor irradiations.** Kneff, D.W.; Skowronski, R.P.; Oliver, B.M.; Greenwood, L.R. (Rockwell International, Canoga Park, CA; Argonne National Lab., IL). Nov 1983. NTIS, PC A07/MF A01. Order Number DE84009143. TI84009143

In Damage analysis and fundamental studies. Quarterly progress report, July-September 1983.

Helium generation measurements and calculations have been performed for 45 nickel samples from nine different fission reactor irradiations, representing a neutron fluence range of 0.1 to 8.0 x 10^{22} neutrons/cm^2. The measurements were made by gas mass spectrometry, and the calculations were based on dosimetry-adjusted neutron spectra and evaluated cross sections, including new evaluations for ^{59}Ni. The measurements and calculations agree to within +-10%, demonstrating the ability to calculate helium levels in nickel accurately for a wide range of reactor spectra and conditions.

28748 (DOE/ER—0046/15, pp 17-25) **14-MeV neutron irradiation of copper alloys.** Zinkle, S.J.; Kulcinski, G.L. (Univ. of Wisconsin, Madison). Nov 1983. NTIS, PC A07/MF A01. Order Number DE84009143. TI84009143

In Damage analysis and fundamental studies. Quarterly progress report, July-September 1983.

Resistivity and Vickers microhardness measurements have been obtained from copper and three copper alloys (Cu + 5% Al, Cu + 5% Mn, Cu + 5% Ni) irradiated at room temperature with 14-MeV neutrons up to a maximum fluence of 3 x 10^{21} n/m^2. The defect cluster density appears to scale linearly with the square root of neutron fluence. Resistivity analysis indicates that about 16% of the Frenkel defects initially created in the cascade escape correlated recombination events. Good agreement has been obtained between resistivity and microhardness estimates of the defect cluster density as compared to densities actually observed by TEM methods.

28749 (DOE/ER—0046/15, pp 26-38) **14-MeV neutron radiation-induced microhardness changes in copper alloys.** Zinkle, S.J.; Kulcinski, G.L. (Univ. of Wisconsin, Madison). Nov 1983. NTIS, PC A07/MF A01. Order Number DE84009143. TI84009143

In Damage analysis and fundamental studies. Quarterly progress report, July-September 1983.

Vickers microhardness measurements have been performed on copper and copper alloy (Cu-5% Al, Cu-5% Mn, Cu-5% Ni) TEM disks which were irradiated at 25°C with 14-MeV neutrons in incremental doses up to a maximum fluence of 2.2 x 10^{21} n/m^2. Measurements were made at two different values of indenter loading (5 g and 10 g) in order to facilitate correlations with high-load data. The radiation-induced change in microhardness scales linearly with the fourth root of neutron fluence following an incubation fluence for both values of indenter load. The copper alloys, in particular Cu-5% Mn, exhibit a shorter incubation fluence and hence a larger radiation-induced hardness increase than the pure copper samples. The 5 g microhardness data has a lower value for the radiation-induced microhardness change compared to the 10 g data due to surface effects. The 10 g microhardness data predictions of defect cluster density agree well with resistivity predictions and TEM observations.

28750 (DOE/ER—0046/15, pp 45-51) **Micromechanical mechanisms of cleavage fracture in martensitic stainless steels.** Odette, G.R.; Lucas, G.E.; Maiti, R.; Sheckherd, J.W. (Univ. of California, Santa Barbara). Nov 1983. NTIS, PC A07/MF A01. Order Number DE84009143. TI84009143

In Damage analysis and fundamental studies. Quarterly progress report, July-September 1983.

Coupled measurements of tensile and blunt and sharp notch fracture properties were made on a prototypical heat of HT-9, which is a 12% Cr martensitic stainless steel. Based on these data, it was found that cleavage fracture is controlled by a critical stress-critical distance criteria. The microcleavage fracture stress is 2400 MPa, consistent with the observed martensite lath packet size; and the critical distance is ~ 50 μm which is consistent with observed prior austenite grain size.

28751 (DOE/ER—0046/15, pp 52-59) **Model for in-reactor stress rupture of austenitic stainless steels.** Odette, G.R. (Univ. of California, Santa Barbara). Nov 1983. NTIS, PC A07/MF A01. Order Number DE84009143. TI84009143

In Damage analysis and fundamental studies. Quarterly progress report, July-September 1983.

A model for in-reactor stress rupture of austenitic stainless steels is proposed. This model is based on stress-induced creep cavity formation on a fraction of an evolving distribution of helium bubbles. Creep deformation and its coupling with creep cavity growth in the boundary, near boundary precipitate free zone and grain matrix are considered. The model is calibrated to some high temperature in-reactor data and extrapolated to lower temperatures where irradiation creep is dominant; relatively high ductilities in breeder spectra are predicted due to delocalization of microstructurally insensitive irradiation creep strains. At low stresses, the rupture exposure is predicted to scale as $\alpha\ 1/\sqrt{\text{He/dpa}}\ \sigma^2$ and the total ductility $1/\sqrt{\text{He/dpa}}\ \sigma$.

28752 (DOE/ER—0046/15, pp 60-65) **Correlation of fracture toughness with tensile properties for irradiated 20% cold-worked 316 stainless steel.** Hamilton, M.L.; Garner, F.A.; Wolfer, W.G. (Hanford Engineering Development Lab., Richland, WA; Univ. of Wisconsin, Madison). Nov 1983. NTIS, PC A07/MF A01. Order Number DE84009143. TI84009143

In Damage analysis and fundamental studies. Quarterly progress report, July-September 1983.

A modified version of the Krafft correlation has been successfully employed to estimate the fracture toughness of irradiated AISI 316 using more easily obtained tensile data. It appears that fracture toughness saturates with neutron exposure at ~ 400°C. It also exhibits a dependence on both irradiation temperature and test temperature.

28753 (DOE/ER—0046/15, pp 66-75) **Dependence on neutron-induced displacement rate of tensile property changes in annealed AISI 304 and 316.** Brager, H.R.; Blackburn, L.D.; Greenslade, D.L. Nov 1983. NTIS, PC A07/MF A01. Order Number DE84009143. TI84009143

In Damage analysis and fundamental studies. Quarterly progress report, July-September 1983.

Annealed specimens of AISI 304 and 316 were irradiated in the EBR-II fast reactor at ~ 400°C over a range of neutron fluxes and energy spectra. Tensile tests show that the hardening of the AISI 304 is sensitive to the displacement rate while the hardening of AISI 316 is not. However, the microstructures of both AISI 304 and 316 are influenced by displacement rate. The increase in yield strength of the specimens is correlated with the contribution of the various microstructural components produced during irradiation. The insensitivity in the hardening of AISI 316 to displacement rate arises because the strengthening contribution from precipitates increases with displacement rate, whereas the strengthening contribution from voids decreases.

28754 (DOE/ER—0046/15, pp 76-80) **Shear punch tests for mechanical property measurements in TEM disc-sized specimens.** Lucas, G.E.; Sheckherd, J.W.; Odette, G.R.; Panchanadeeswaran, S. (Univ. of California, Santa Barbara). Nov 1983. NTIS, PC A07/MF A01. Order Number DE84009143. TI84009143

In Damage analysis and fundamental studies. Quarterly progress report, July-September 1983.

A shear punch test has been developed to extract strength and ductility information from thin sheet samples as small as transmission electron microscopy (TEM) disc specimens. The test is based on driving a cylindrical punch through a clamped specimen, and instrumenting the punch to obtain a load-displacement curve of the punching process. A number of correlations have been developed between features of the load-displacement curve and mechanical properties such as yield strength, ultimate tensile strength, work hardening exponent and reduction in area.

28755 (DOE/ER—0046/15, pp 82-88) **Theoretical assessment of the effect of microchemical, microstructural and environmental mechanisms on swelling incubation in austenitic stainless steels.** Odette, G.R.; Stoller, R.E. (Univ. of California, Santa Barbara). Nov 1983. NTIS, PC A07/MF A01. Order Number DE84009143. TI84009143

In Damage analysis and fundamental studies. Quarterly progress report, July-September 1983.

The sensitivity of swelling incubation in austenitic steels is assessed. A critical-sized helium bubble-to-void conversion model is used to evaluate the influence of helium partitioning, sink strength, surface energy and diffusion rates which mediate microchemical, microstructural and environmental effects. Several new mechanisms of precipitate-enhanced (and retarded) void formation are proposed. While such microchemical effects are important, they were not found to be dominant in all cases. The results suggest that unless fine distributions of helium can be maintained, swelling will be higher in fusion than in either fast or mixed spectrum fission environments.

28756 (DOE/ER—0046/15, pp 89-95) **Factors that determine the swelling behavior of austenitic stainless steels.** Garner, F.A.; Wolfer, W.G. (Hanford Engineering Development Lab., Richland, WA; Univ. of Wisconsin, Madison). Nov 1983. NTIS, PC A07/MF A01. Order Number DE84009143. TI84009143

In Damage analysis and fundamental studies. Quarterly progress report, July-September 1983.

Once void nucleation subsides, the swelling rate of many austenitic alloys becomes rather insensitive to variables that control the transient regime of swelling. Models are presented which describe the roles of nickel, chromium and silicon in void nucleation. The relative insensitivity of steady-state swelling to temperature, displacement rate and composition is also discussed.

28757 (DOE/ER—0046/15, pp 96-100) **Lithium shell effect and its impact on microscopy determinations of swelling behavior.** Yang, W.J.S.; Garner, F.A.; Kumar, A. (Hanford Engineering Development Lab., Richland, WA; Univ. of Missouri, Rolla). Nov 1983. NTIS, PC A07/MF A01. Order Number DE84009143. TI84009143

In Damage analysis and fundamental studies. Quarterly progress report, July-September 1983.

The heterogeneity of swelling in some irradiated alloys arises from localized enhancement of void nucleation by the lithium shell effect near boron-rich precipitates. It has been found that these lithium-affected volumes can be discounted in microscopy determinations of the bulk-averaged swelling rate.

28758 (DOE/ER—0046/15, pp 101-106) **Conditions for the suppression of void formation during ion-bombardment.** Plumton, D.L.; Attaya, H.; Wolfer, W.G. (Univ. of Wisconsin, Madison). Nov 1983. NTIS, PC A07/MF A01. Order Number DE84009143. TI84009143

In Damage analysis and fundamental studies. Quarterly progress report, July-September 1983.

In the region of ion deposition the number of interstitials is larger than the number of vacancies produced by displacement damage. As a result void formation can be suppressed. The following conditions must be satisfied for the suppression to occur: the distribution of injected ions an the distribution of displacement damage must overlap; within this region of overlap, the irradiation conditions must be such that recombination is a significant process. It is shown that void-free zones along the ion range can be pro-

duced bordering on regions with voids both behind and in front of the displacement damage peak. The suppression of void formation is particularly severe in low-energy ion bombardments.

28759 (DOE/ER—0046/15, pp 107-113) **Correlation of helium content and microstructure to bubble growth in helium irradiated thin films of nickel.** Sattler, M.L.; Jesser, W.A. (Univ. of Virginia, Charlottesville). Nov 1983. NTIS, PC A07/MF A01. Order Number DE84009143. TI84009143

In Damage analysis and fundamental studies. Quarterly progress report, July-September 1983.

Thin PVD nickel films were irradiated at 80 keV by monoenergetic helium ions to fluences as high as $10^{22} m^{-2}$. Those samples containing bubbles were subsequently annealed in a TEM at 550, 600, and 650°C for 90 minutes each. Individual volume changes were monitored for about 40 bubbles during the anneal. Annealing at 550 and 600°C showed all bubble sizes growing regardless of location. Annealing at 650°C showed small bubbles shrinking and large ones growing apparently via an Ostwald ripening mechanism. Finally, the films were vaporized in a mass spectrometer to measure retained helium. For the sample with visible bubbles only, 55% of the measured retained helium was needed to fill each bubble to equilibrium at 650°C. A saturation level of helium retained in the samples was found to be $8 \times 10^{20} m^{-2}$ (0.8%) for specimens with no visible bubbles and irradiated at 550°C; over twice as much retained helium was found in bubble-containing specimens irradiated at ~ 750°C.

28760 (DOE/ER—0046/15, pp 114-119) **Thermal creep and stress-affected precipitation of 20% cold-worked 316 stainless steel.** Puigh, R.J.; Lovell, A.J.; Garner, F.A. Nov 1983. NTIS, PC A07/MF A01. Order Number DE84009143. TI84009143

In Damage analysis and fundamental studies. Quarterly progress report, July-September 1983.

Measurements of the thermal creep of 20% cold-worked 316 stainless steel have been performed for temperatures from 593 to 760°C, stress levels as high as 138 MPa and exposure times as long as 15,000 hours. The creep strains exhibit a complex behavior arising from the combined action of true creep and stress-affected precipitation of intermetallic phases. The latter process is suspected to be altered by neutron irradiation.

28761 (DOE/ER—0046/15, pp 127-132) **Irradiated behavior of high-strength copper alloys.** Zinkle, S.J.; Farrens, S.N.; Kulcinski, G.L.; Dodd, R.A. (Univ. of Wisconsin, Madison). Nov 1983. NTIS, PC A07/MF A01. Order Number DE84009143. TI84009143

In Damage analysis and fundamental studies. Quarterly progress report, July-September 1983.

This report describes the initial efforts of a program designed to investigate the irradiation properties of two commercial high-strength, high-electrical conductivity copper alloys. Resistivity and microhardness measurements have been performed on as-received AMZIRC and AMAX-MZC copper alloys in order to help characterize their initial properties. In addition, 14-MeV Cu ion irradiations have been completed on 8 samples at temperatures between 300°C and 700°C (0.4 to 0.7 T/sub M/) at calculated peak damage levels between 4 and 40 dpa. The correlated yield strength of the unirradiated alloys as obtained from microhardness measurements agrees well with values supplied by the manufacturer but the measured electrical conductivities are significantly less than the manufacturer's values.

28762 (DOE/ER/01198—1409) **Rapid solidification and undercooling of Aluminum Germanium alloys: characterization and control of microstructure.** Kaufman, M.J. (Illinois Univ., Urbana (USA)). 1984. Contract AC02-76ER01198. 197p. NTIS, PC A09/MF A01; 1; GPO Dep. Order Number DE84012395.

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In addition to the in-situ solidification and undercooling studies, melt spun ribbons, splat quenched foils and amorphous films of similar compositions have been analyzed. The as-produced microstructures were characterized in the microscope and, subsequently, the amorphous films were heated with the beam to cause crystallization, the products of which were found to vary with composition and heating rate. From these observations, it appears that temperature ranges exist, whether approached by down-quenching from the liquid state or up-quenching from the amorphous state, where the formation of the different phases becomes favorable and that the primary function of cooling rate during rapid solidification is to inhibit nucleation processes so that substantial undercoolings may be achieved. A computer model has been developed in an effort to predict the number of grains which form in highly undercooled Al-30Ge (eutectic) droplets. Specifically, this model utilizes modified nucleation and growth equations for glass forming alloys to predict the number of α-Al grains which form upon solidification. It is shown that the number of grains increases significantly as the initial undercooling is raised. However, as the undercooling temperatures approach the glass transition temperature, the number of grains is predicted to drop suddenly toward zero resulting in the formation of amorphous (or partially amorphous) microstructures. These predictions are in good agreement with the experimental observations.

28763 (DOE/ER/03166—34) **Environment and fracture.** Johnson, H.H. (Cornell Univ., Ithaca, NY (USA). Dept. of Materials Science and Engineering). 1984. Contract AC02-76ER03166. 45p. (COO—3166-34). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE84011454.

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A study of hydrogen transport through the glassy metal alloy $Fe_{40}Ni_{40}P_{16}B_6$ is reported. A thin layer of electrodeposited palladium eliminated surface impedances to hydrogen entry and exit. Sievert's law behavior was observed over the pressure (10^3 to 10^5 Pa) and temperature (313 to 353°K) ranges studied. An excellent fit to permeation transients was obtained from numerical solution of Fick's diffusion equation without trapping. Diffusivities derived from least squares fitting of transients were in good agreement with those obtained from time lag measurements. The results were not influenced by trapping, as within the concentration range studied, diffusivities were not influenced by concentration. Permeating measurements on stressed iron membranes established that the phenomenological partial atomic volumes of hydrogen and deuterium are equal.

28764 (DOE/ER/10910—03) **Investigation of role of subsurface zones in wear of materials. Progress report, June 1, 1983-May 31, 1984.** Solecki, R.; Nowotny, H.; Rice, S.L. (Connecticut Univ., Storrs (USA)). May 1984. Contract AC02-81ER10910. 4p. NTIS, PC A02/MF A01; GPO Dep. Order Number DE84012752.

This report presents experimental and theoretical results from investigations conducted on the role of subsurface zones in wear of materials. Wear tests in both sliding and compound impact modes have been carried out on a variety of metallic materials. Significant experimental results include findings from stiffness, material pair reversal, hardness reversal test series and geometry contact studies.

28765 (DOE/ER/45030—1) **Heat transfer, fluid flow and element vaporization in laser welding. Progress report, August 1, 1983-July 31, 1984.** DebRoy, T. (Pennsylvania State Univ., University Park (USA). Dept. of Materials Science and Engineering). Mar 1984. Contract AC02-83ER45030. 25p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE84011783.

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Alloying element vaporization rates, plasma composition and the changes in weld composition during laser welding of AISI 202 stainless steel are discussed in this report. Iron, manganese and chromium were the most dominant species in the plasma. During laser welding it is always a difficult task to measure the temperature of the weld pool since this region is surrounded by hot plasma. In this report a novel technique for the determination of weld pool temperature is presented. It is demonstrated that the relative rates of vaporization of any two elements from the molten pool can serve as an indicator of the weld pool temperature, irrespective of the element pair selected. The composition of the solidified region calculated from the measured values of vaporization rate, plasma composition and the volume of the solidified region was in good

agreement with the weld composition determined by electron probe microanalysis technique.

28766 (DOE/ET/15322—T6) Behavior of Ni-Cr-Si coating alloys in Na_2SO_4, V_2O_5, and mixed salt hot corrosion. Final report. Corey, R.G.; Khan, A.S.; Barkalow, R.H.; Hecht, R.J. (Pratt and Whitney Aircraft, West Palm Beach, FL (USA). Government Products Div.). 1 Oct 1983. Contract AC06-79ET15322. 52p. (FR—15738). NTIS, PC A04/MF A01; GPO Dep. Order Number DE84012386.

This report describes the results of a program to select coating alloys that are resistant to vanadium- and sulfate-induced hot corrosion and solid particle erosion in the 700 to 900°C temperature range. Test materials, methods, and results are discussed. The principal alloy coatings that were tested were high-chromium, nickel-base alloys with additions of silicon, aluminum, and tantalum.

28767 (DP-MS—83-123) Upset weld study for joining 304L stainless steel tubes. Kanne, W.R. Jr. (Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Plant). Mar 1984. Contract AC09-76SR00001. 38p. (CONF-840448—4). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE84011507.

From 65. annual American Welding Society convention; Dallas, TX, USA (9 Apr 1984).

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Tube samples made from bar and forgings were joined using resistance upset welding technique. Effects of joint design, base metal strength, and weld schedule on metal flow and final microstructure were determined. Studies of the effects of joint design on weld quality permitted selection of an optimum design. Welds joining tubes of four strengths showed that weld centerline hardness is independent of initial material hardness and is greater than that of fusion welds. A wide range of welding parameters was shown to produce satisfactory welds. Bar stock was used for additional studies. These studies determined force and current ranges, improved weld quality, and demonstrated welding in air.

28768 (GKSS—83/E/32) dpa calculations for neutron irradiated amorphous $Fe_{40}Ni_{40}B_{20}$ ribbons. Schimansky, F.P.; Gerling, R. (GKSS-Forschungszentrum Geesthacht G.m.b.H., Geesthacht-Tesperhude (Germany, F.R.)). 1983. 28p. (In German). NTIS (US Sales Only), PC A03/MF A01. Order Number DE84751295.

With 5 figs., 1 tab.

Calculations of the displacement per atom have been performed for an amorphous metal $Fe_{40}Ni_{40}B_{20}$, which has been exposed to incore reactor irradiation. Up to 99% of the radiation induced displacements result from the nuclear reaction $^{10}B(n,\alpha)^7Li + 2.79$ MeV, which is initiated by thermal neutrons. The number of primary knock-on atoms generated by α- and Li-particles and the size of cascades have also been calculated. A fluence of thermal neutrons of 1×10^{19} nsub(th)/cm^2 is found to produce a damage in amorphous $Fe_{40}Ni_{40}B_{20}$ which corresponds to 0.65 dpa.

28769 (GKSS—83/E/48) Influence of sea water pretreatment and flow velocity on the corrosion behaviour of some modified aluminium alloys in North Sea water. Venkateswaran, G.; Galow, E. (GKSS-Forschungszentrum Geesthacht G.m.b.H., Geesthacht-Tesperhude (Germany, F.R.)). 1983. 65p. NTIS (US Sales Only), PC A04/MF A01. Order Number DE84751598.

Four modified aluminium alloys in annealed and cold rolled forms have been prepared and their corrosion characteristics in deaerated and inhibited North Sea water media under dynamic and static conditions have been studied. A mixture of 50 ppm potassium chromate and 100 ppm sodium hydrogencarbonate has resulted in a total suppression of the pitting attack. The dynamic corrosion characteristics of prefilmed aluminium brass and and 90-10 copper-nickel have also been studied in aerated and deaerated North Sea water media and compared with those of aluminium alloys.

28770 (HEDL—7447) Evaluation of ferritic alloy Fe-2-1/4Cr-1Mo after neutron irradiation - microstructure development. Gelles, D.S. (Hanford Engineering Development Lab., Richland, WA (USA)). May 1984. Contract AC06-76FF02170. 51p. NTIS, PC A04/MF A01; 1; GPO Dep. Order Number DE84012376.

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Microstructural examinations are reported for nine specimen conditions of 2-1/4Cr-1Mo steel which had been irradiated by fast neutrons over the temperature range 390 to 510°C. Two heats of material were involved, each with a different preirradiation heat treatment, one irradiated to a peak fluence of 5.1×10^{22} n/cm^2 ($E > 0.1$ MeV) or 24 dpa and the other to 2.4×10^{23} n/cm^2 ($E > 0.1$ MeV) or 116 dpa. Void swelling is found following irradiation at 400°C in both conditions and to 480°C in the higher fluence conditions. Concurrently dislocation structure and precipitation formed. Peak void swelling, void density, dislocation density and precipitate number density developed at the lowest temperature, ~ 400°C, whereas mean void size, and mean precipitate size increased with increasing irradiation temperature. The examination results are used to provide interpretation of in-reactor creep, density change and post irradiation tensile behavior.

28771 (HEDL-SA—3024-A) Model describing the compositional dependence of void nucleation in irradiated Fe-Ni-Cr alloys. Garner, F.A.; Kumar, A.; Esmailzadeh, B. (Hanford Engineering Development Lab., Richland, WA (USA); Missouri Univ., Rolla (USA)). Feb 1984. Contract AC06-76FF02170. 2p. (CONF-840604—4). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE84010320.

From 12. international symposium on effects of radiation on materials; Williamsburg, VA, USA (18 Jun 1984).

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Recent experimental studies have shown that the major influence of environmental and material variables on the void swelling of Fe-Ni-Cr austenitic alloys resides in the duration of the transient regime. The post-transient or steady-state regime is remarkably insensitive to the factors that control void nucleation and reflects the tendency of radiation-induced microstructures to evolve toward a condition that assures attainment of the intrinsic swelling rate of Fe-Ni-Cr austenitic alloys, ~ 1%/dpa. These insights have led to a change of focus from rate theory descriptions of swelling to void nucleation theory. It is shown that the major features of the compositional dependence of swelling in simple austenitic alloys can be explained in terms of the compositional dependence of vacancy diffusivity and its impact on void nucleation. The model is demonstrated for the effects of nickel, chromium, silicon and phosphorus.

28772 (IC—83/59) New scaling results in quantum percolation. Srivastava, V.; Chaturvedi, M. (International Centre for Theoretical Physics, Trieste (Italy)). Jun 1983. 11p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE84701675.

Scaling arguments for distribution of cluster size and size of localized states have been developed to calculate average number of lattice sites falling under a localized wave function as a function of concentration for a model binary system with "infinite disorder". We find distinct features near classical and quantum percolation thresholds. Analytical results are compared with computer-experiment results and the predicted features are found to be confirmed. Possibility of appearance of extended states in two-dimensional binary systems even at infinite disorder is pointed out.

28773 (INIS-mf—8387) Electrochemical investigations on the corrosion of gas turbine materials in sulfate melts with and without superimposed mechanical stress. Schmidt, M. (Technische Hochschule Darmstadt (Germany, F.R.). Fachbereich Maschinenbau). 27 Jul 1981. 151p. (In German). NTIS (US Sales Only), PC A08/MF A01. Order Number DE84780229.

The corrosion behavior of several gas turbine alloys has been investigated with electrochemical methods at high temperatures in sulfate melts. Additionally experiments with superimposed mechanical stress have been performed on a nickel base alloy. As

corrosive medium the sulfates $(Na_2,Ca,Mg)SO_4$ and $(Na,K)_2 SO_4$ were selected. (orig.).

28774 **(INIS-mf—8396) Gasemission and surface modifications during helium implantation on nickel surfaces.** Ehrenberg, J.K. (Muenchen Univ. (Germany, F.R.). Fakultaet fuer Physik). 25 Feb 1982. 154p. (In German). NTIS (US Sales Only), PC A08/MF A01. Order Number DE84780237.

Simultaneous measurements are reported of the helium reemission and the surface modifications of poly- and single crystal nickel surfaces during helium ion-implantation at energie between 20 keV-150 keV in the temperature range 25°C-950°C. In addition the He depth-profiles have been measured using the nuclear reaction method $^3H(d,\alpha)H$. The binding characteristics of He in nickel is studied by isochronous annealing of the samples after the implantation process and a subsequent measurement of the desorption spectra, and the surfaces are investigated by optical microscopy and scanning electron microscopy. For all implantation energies and impact temperatures together with the surface modifications a simultaneous increase in helium reemission is observed at a critical fluency value, which depends on temperature and implantation energy. A qualitative explanation of the empirical relation between reemission rate and blister formation rate is given on the basis of a lateral stress model for blister formation. (orig./GSCH).

28775 (INIS-mf—8901, pp 192-197) **Internal state distributions of molecules scattering and desorbing from surfaces.** Auerbach, D.J. (IBM Research Div., San Jose, CA (USA)). 1983. NTIS (US Sales Only), PC A14/MF A01. Order Number DE84701920. (CONF-830120—Exc.). TI84701920

From Symposium on surface science; Obertraun, Austria (30 Jan 1983).

Attempts are made to interpret scattering experiments of NO molecules on Ag(111) where a (rotational) state-specific detector has been used. A model using an anisotropic potential is proposed to explain the observed incoming energy- and angle dependence. The so-called rotational rainbows are explained. It is concluded, that in this way information on intermolecular potentials and the transfer of translational to rotational energy in the dynamics of trapping and sticking of molecules on surfaces can be extracted. (G.Q.).

28776 (INIS-mf—8901, pp 277-281) **Atomprobe-analysis of interfaces and grain boundaries in stainless steel welds.** Leisch, M. (Techn. Univ. Graz (Austria). Institut fuer Festkoerperphysik). 1983. NTIS (US Sales Only), PC A14/MF A01. Order Number DE84701920. (CONF-830120—Exc.). TI84701920

From Symposium on surface science; Obertraun, Austria (30 Jan 1983).

Atomic probe analysis were used to obtain composition profiles from untreated, annealed and spot-welded 304 stainless steel. (G.Q.).

28777 (INIS-mf—8901, pp 264-269) **FIM-Investigations of H_2, N_2 and O_2 interactions with the niobium surface.** Krautz, E.; Haiml, G. (Techn. Univ. Graz (Austria). Institut fuer Festkoerperphysik). 1983. NTIS (US Sales Only), PC A14/MF A01. Order Number DE84701920. (CONF-830120—Exc.). TI84701920

From Symposium on surface science; Obertraun, Austria (30 Jan 1983).

The importance of gases dissolved in the host material to the imaging is discussed. (G.Q.).

28778 (INIS-mf—8921, pp 18) **Effects of static disorder on the transport properties of a metallic system.** Ovadyahu, Z. (Ben-Gurion Univ. of the Negev, Beersheba (Israel). Dept. of Physics). 1983. NTIS (US Sales Only), PC A05/MF A01. Order Number DE84780235. (CONF-8303128—Summ.). TI84780235

From Israel Physical Society annual meeting; Ramat-Gan, Israel (24 Mar 1983).

28779 (INIS-mf—8921, pp 27) **New transport phenomena near the Anderson transition: power law localization.** Kaveh, M. (Bar-Ilan Univ., Ramat-Gan (Israel). Dept. of Physics). 1983. NTIS (US Sales Only), PC A05/MF A01. Order Number DE84780235. (CONF-8303128—Summ.). TI84780235

From Israel Physical Society annual meeting; Ramat-Gan, Israel (24 Mar 1983).

28780 (INIS-mf—8921, pp 63) **Debye temperature of Ti in TiO_2, TiH_2 and TiC.** Shahal, O.; Moreh, R.; Jacob, I.; Mintz, M.H.; Wolf, A. (Israel Atomic Energy Commission, Beersheba. Nuclear Research Center-Negev). 1983. NTIS (US Sales Only), PC A05/MF A01. Order Number DE84780235. (CONF-8303128—Summ.). TI84780235

From Israel Physical Society annual meeting; Ramat-Gan, Israel (24 Mar 1983).

28781 (INIS-mf—8921, pp 64) **M agnetic transitions in ultra-thin iron layers.** Hirsch, A.A.; Massalha, T. (Technion-Israel Inst. of Tech., Haifa. Dept. of Physics). 1983. NTIS (US Sales Only), PC A05/MF A01. Order Number DE84780235. (CONF-8303128—Summ.). TI84780235

From Israel Physical Society annual meeting; Ramat-Gan, Israel (24 Mar 1983).

28782 (INIS-mf—8921, pp 80) **Vertical unseeded vapor growth of large Cdsub(1-x)Znsub(x)Te crystals.** Ben-Dor, L. (Hebrew Univ., Jerusalem (Israel)); Yellin, N.; Tsigelman, A. (Israel Atomic Energy Commission, Yavne. Soreq Nuclear Research Center). 1983. NTIS (US Sales Only), PC A05/MF A01. Order Number DE84780235. (CONF-8303128—Summ.). TI84780235

From Israel Physical Society annual meeting; Ramat-Gan, Israel (24 Mar 1983).

28783 (INIS-mf—8921, pp 83) **Ultra-thin continuous Pb films by coevaporation with Ge.** Rappaport, M.L. (Tel Aviv Univ. (Israel). Dept. of Physics and Astronomy). 1983. NTIS (US Sales Only), PC A05/MF A01. Order Number DE84780235. (CONF-8303128—Summ.). TI84780235

From Israel Physical Society annual meeting; Ramat-Gan, Israel (24 Mar 1983).

28784 (INIS-mf—8921, pp 85) **Irreversible magnetization in Co-W thin films.** Admon, U.; Dariel, M.P.; Kimmel, G. (Israel Atomic Energy Commission, Beersheba. Nuclear Research Center-Negev); Grunbaum, E. (Tel Aviv Univ. (Israel). Dept. of Engineering Sciences). 1983. NTIS (US Sales Only), PC A05/MF A01. Order Number DE84780235. (CONF-8303128—Summ.). TI84780235

From Israel Physical Society annual meeting; Ramat-Gan, Israel (24 Mar 1983).

28785 **(Juel—1849) Hydrogen influence on the superconductivity of the non-transition elements.** Ochmann, F. (Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.). Inst. fuer Festkoerperforschung; Koeln Univ. (Germany, F.R.)). May 1983. 52p. (In German). NTIS (US Sales Only), PC A04/MF A01. Order Number DE84751294.

The aim of this work was to perform a systematic study of the hydrogen influence on the superconductivity of the non-transition elements, Be, Zn, Cd, In, Sn, Tl and Pb. For hydrogen is almost insoluable in these metals it was introduced into the host lattices by ion implantation at low temperatures. In all cases the critical temperature could be enhanced. In comparison the implantation of deuterium also lead to an improved superconductivity. The observed isotope effects are not understood. By implantation of He those effects on the critical temperature were measured, which occur by radiation damage caused by H(D) implantation. The critical temperatures achieved in these experiments were always significantly smaller than those caused by H and D respectively. By an application of McMillan's theory it was possible to show that a phononic origin of the hydrogen effect can explain the experimental results.

28786 **(K/PS—5033) Aspects of electroless nickel plating on molybdenum.** Mikkola, R.D.; Daugherty, C.E.; Harris, G.E.; Neff, W.A.; Owens, W.W. (Oak Ridge Gaseous Diffusion Plant, TN (USA)). Jul 1984. Contract W-7405-ENG-26. 15p. (CONF-840711—2). NTIS, PC A02/MF A01; GPO Dep. Order Number DE84006434.

From American Electroplaters' Society SUR/FIN '84 conference; New York, NY, USA (1 Jul 1984).

A process for depositing an adherent coating of an electroless nickel-phosphorus alloy on molybdenum was developed. The required pretreatment processes included an anodic etch in a chromic acid-nitric acid solution, an anodic etch in a phosphonic acid solution, and an oxide stripping step in a chromic acid-nitric acid solution. Initiation of the electroless nickel plating was accomplished through a series of strikes in the nickel bath. Scale up from laboratory parts to large components involved optimization of parameters such as pretreat time, current density, anode to cathode ratio and strike time.

28787 **(KFK—3605) Investigations of the preparation and properties of 'new' Si-Mn sintered steels.** Klein, A.N. (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Inst. fuer Material- und Festkoerperforschung; Karlsruhe Univ. (T.H.) (Germany, F.R.)). Sep 1983. 118p. (In German). NTIS (US Sales Only), PC A06/MF A01. Order Number DE84751596.

Sintered steels with Si-contents up to 2.5 wt.% and Mn-contents up to 4.5 wt.% with and without additional carbon were prepared by single and double sintering processes. On a laboratory scale, the sintering was carried out in the temperature range of 1150-1250°C. The master alloys used were ferrosilicon (15.4 wt.% Si), ferromanganese (84.7 wt.% Mn) and a ternary Fe-Si-Mn master alloy. The sintering behaviour was investigated using the dilatometer, differential thermal analysis and microscopic methods. Microprobe analysis and quantitative metallography were used to investigate the homogenization behaviour and the results obtained were compared with those of theoretical predictions based on the concentric sphere model. Using the ferroalloys, tensile strengths up to 750 MPa can be achieved; the use of the ternary alloy leads to strengths up to 1000 MPa when single sintering process is used. The elongation at fracture is about 3%. The sintered steels are dimensionally stable over a wide range of compositions. The microstructure of the alloys after cooling from the sintering temperature (approx.= 40 K/min) reveal the existence of martensite and bainite, whose content depends on the composition.

28788 **(NUREG/CR—3506) J-R curve characterization of irradiated low upper shelf welds.** Hiser, A.L.; Loss, F.J.; Menke, B.H. (Materials Engineering Associates, Inc., Lanham, MD (USA)). Apr 1984. 614p. (MEA—2028). NTIS, PC A99/MF A01 - GPO* $11.00. Order Number DE84901084.

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This investigation provides a data base of J-R curve trends from irradiated A 508 and A 533-B weld metals exhibiting low upper shelf Charpy-V (C/sub v/) energy. These welds were made with Linde 80 flux of the same lots used for vessels currently in service. These materials exhibited postirradiation C/sub v/ upper shelf energies of 58 J to 80 J. Compact toughness (CT) specimens of four different sizes (0.5T- to 4T-CT) were characterized. These specimens were irradiated to a fluence of $\sim 1 \times 10^{19}$ n/cm^2 > 1 MeV as part of the NRC-sponsored HSST program. The J-R curves exhibited a power-law behavior for small crack extensions (e.g., < 2 mm). Irradiation decreased the level of the R-curve significantly in most cases. The value of J-integral at the initiation of crack growth (J/sub Ic/) decreased on average by ~ 25% at 200°C and by ~ 35% at 288°C. The average value of tearing modulus (T/sub avg/) was a more discriminating indication of the degradation due to irradiation, as T/sub avg/ decreased on average by ~ 54% at 200°C and by ~ 69% at 288°C. A modest size effect associated with larger specimens was indicated for tests in the unirradiated condition, while no size effect was apparent for tests in the irradiated condition. These data comppare favorably with correlations between C/sub v/ upper shelf energy and J-R curve parameters observed from prior studies with 1T-CT specimens. These correlations could enhance the significance of C/sub v/ reactor surveillance data with respect to structural integrity.

28789 **(NUREG/CR—3546) Temperature dependence of fatigue crack growth rates of A 351 CF8A cast stainless steel in LWR environment.** Cullen, W.H.; Taylor, R.E.; Torronen, K.; Kemppainen, M. (Materials Engineering Associates, Inc., Lanham, MD (USA)). Apr 1984. 44p. (MEA—2030). NTIS, PC A03/MF A01 - GPO* $3.75. Order Number DE84901128.

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The fatigue crack growth rates for A 351-CF8A cast stainless steel were determined over a range of temperatures from 95°C to 338°C (200°F to 640°F). The waveform was 17 mHz sinusoidal and the load ratio was 0.2. The environment was borated and lithiated water with a dissolved oxygen content of ~ 1 ppB. The results show an easily measurable (factors of 2 to 8) increase in crack growth rates due to the environment. However, these rates are well within the known band of results for low-alloy pressure vessel and low-carbon piping steels in LWR environments. An extensive fractographic investigation shows fatigue fracture surfaces covered with brittle-like features. This morphology is similar to that resulting from the environmental assistance mechanism producing increased crack growth rates due to stress-corrosion cracking.

28790 **(PB—84-152156) Increasing the leaching rate of bulk superalloy scrap by melting with aluminum. Report of investigations/1983.** Atkinson, G.B. (Bureau of Mines, Reno, NV (USA). Reno Research Center). Dec 1983. 18p. (BM-RI—8833). NTIS, PC A02/MF A01.

The Bureau of Mines investigated a method for increasing the leaching rate of bulk superalloy scrap to facilitate recycling and recovery of critical metals such as Ni, Co, and Cr. Three superalloys were investigated, the cast-nickel-base superalloy IN-738, the wrought-nickel-base superalloy Rene-41, and the cast-cobalt-base superalloy Mar-M-509. Superalloys melted with 20, 30, 40, and 50 pct Al metal to form intermetallic compounds were easily crushed to a convenient particle size and reacted rapidly with acid solutions which dissolved the metals. For example, leaching 1/2-in pieces of unalloyed IN-738 with excess 6N HCl at 95 degree C for 2 h dissolved about 0.5 pct, while leaching 10 g of minus 20-mesh 30 pct Al-70 pct IN-738 with excess 6N HCl at 95 degrees C for 2 h dissolved 96.2 pct.

28791 **(PNL-SA—12116) Environmental assisted fracture of cast and wrought mild steels in brine.** Pitman, S.G.; Hall, E.E. (Pacific Northwest Lab., Richland, WA (USA)). Mar 1984. Contract AC06-76RL01830. 5p. (CONF-840307—42). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE84011870.

From Waste management '84; Tucson, AZ, USA (11 Mar 1984).

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Two test methods, slow strain rate (SSR) tests and corrosion fatigue tests, are being used to investigate the susceptibility of wrought and cast mild steels to environmentally assisted fracture. The SSR test provides an assessment of relative cracking susceptibility, and is most useful for comparing the effects of different environments on a given material, and for measuring the relative susceptibility of different materials to environmentally assisted cracking in a given environment. The corrosion fatigue test measures the stress intensity (which is proportional to stress times the square root of crack length) below which an existing flaw or crack will not grow. The test may also prove useful in measuring the stress intensity that provides an acceptable rate of crack growth. The SSR test has been used to investigate the effects of strain rate, temperature, and solution oxygen content on frature properties of mild steel. The results of currently available corrosion fatigue tests are limited to crack growth rate measurements at one frequency in air and in brine. These measurements will be part of an overall program to evaluate allowable stress intensities, but this evaluation cannot be made until measurements are taken at different frequencies and at lower stress intensities. This report, then, discusses the background of SSR testing, experimental procedures, results, and conclusions.

28792 (RHO-BW-SA—314-P) Corrosion behavior of low-carbon steels in Grande Ronde basalt groundwater in the presence of basalt-bentonite packing. Anantatmula, R.P.; Delegard, C.H.; Fish, R.L. (Rockwell International Corp., Richland, WA (USA). Rockwell Hanford Operations). Nov 1983. Contract AC06-77RL01030. 17p. (CONF-831174—87). NTIS, PC A02/MF A01; GPO Dep. Order Number DE84011715.

From Materials Research Society annual meeting; Boston, MA, USA (14 Nov 1983).

Three low-carbon steels (AISI 1006, AISI 1020, and AISI 1025) were tested at 150° and 250°C in Hanford Grande Ronde Basalt groundwater (9.75) pH) under anoxic conditions (≦ 0.1 mg/L oxygen in water) in packing (75 wt% basalt + 25 wt% bentonite) for 1 and 2 weeks. Testing was initially performed in air-equilibrated groundwater (oxic conditions) without packing at 150°C. The average corrosion under anoxic conditions with packing was at least a factor of seven lower than that for oxic conditions at 150°C. The data indicated that carbon composition apparently affects the corrosion of low-carbon steel under oxic conditions. Under anoxic conditions with packing, corrosion was independent of the carbon composition of the steel as evidenced by almost equal weight losses for all three steels at 150° and 250°C. The weight loss at 250°C was about the same as that at 150°C due to the formation of a very adherent layer of iron-rich clay on the surface of the steel at 250°C, reducing the rate at which corrosion proceeds. Pitting was not detected in any of the specimens. Assuming linear corrosion kinetics, extrapolation of the 2-week data to 1,000 yr resulted in approximately 12 mm penetration of the low-carbon steel in Grande Ronde Basalt groundwater under anoxic conditions with packing.

28793 (SAND—84-0708) Sodium compatibility of refractory metal alloy/304L braze joints. Hosking, F.M. (Sandia National Labs., Albuquerque, NM (USA)). May 1984. Contract AC04-76DP00789. 47p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE84012877.

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Vacuum induction brazing of Mo, Re, Ta, and W aloys to 304L stainless steel with AWS BNi filler metals was investigated. Metal powder (BNi-5 and BNi-7) and metallic glass (BNi-3 and modified BNi-5) brazing alloys were evaluated. Excellent braze joints were obtained with the BNi-3 and modified BNi-5 metallic glass foils. Cracks and porosity were observed in the metal powder BNi-5 and BNi-7 brazes. The as-brazed, refractory metal/304L samples were also qualified in a sodium environment of 1073°K (1472°F)/130 hours/2 and 100 ppM oxygen concentration. There was no significant chemical corrosive attack observed on any of the sodium samples and weight changes were generally negligible. Braze separation along the refractory metal interface and crack growth in the filler metal, however, were observed in the metal powder brazes after the sodium exposures. As a result, the metal powder fillers were not recommended. A band of discontinuous voids in the metallic glass brazes near the refractory metal interface was also detected. Metallographic, thermal and microprobe analyses revealed that these voids were caused by a diffusion mechanism called Kirkendall porosity. Since the voids were not connected and would not provide a leak path, the metallic glass filler metals were recommended for brazing refractory metal alloys to 304L and for subsequent sodium exposures.

28794 (UCID—19605-84-1) Metal finishing and vacuum processes groups - Materials Fabrication Division. Progress report, November 1983-February 1984. Romo, J.G.; Dini, J.W. (Lawrence Livermore National Lab., CA (USA)). 27 Mar 1984. Contract W-7405-ENG-48. 13p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE84011046.

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Fabrication developments and activities are reported in support of the following programs: weapons; nuclear test; nuclear design; magnetic fusion; laser; and miscellaneous. (DLC)

28795 (Y—2299) Ultrasonic determination of grain size in uranium. Brosey, W.D. (Oak Ridge Y-12 Plant, TN (USA)). 11 May 1984. Contract AC05-84OS21400. 18p. NTIS, PC A02/MF A01; GPO Dep. Order Number DE84011819.

An ultrasonic attenuation technique for determining the grain size in wrought uranium has been developed to provide routine measurements in a production environment. This method uses a pitch-catch ultrasonic analysis to measure the frequency response in a uranium part and correlate it with the response from a set of standards with known grain size. Effects of part curvature and coupling media on the measurement have been addressed as well as the effect of transducer frequency bandwidth on the range of grain sizes that can be resolved. It has been determined that the frequency response of the ultrasonic signal provides an accurate measurement of the grain size in uranium.

28796 High field performance of superconducting magnets using powder metallurgy processed Cu-Nb-Sn and Nb-Al. Zaleski, A.J.; Foner, S. (Francis Bitter National Magnet Laboratory and Plasma Fusion Center, Massachusetts Institute of Technology, Cambridge, Massachusetts 02139). *Applied Physics Letters;* **44**: No. 11, 1098-1100(1 Jun 1984).

Small superconducting magnets were fabricated with powder metallurgy processed Nb-Al wire and with powder metallurgy processed multistrand Cu-Nb—Sn wire with 19 tin cores. Tests in a background field of up to 15 T showed that short sample characteristics were achieved for three coils. Upper limits of resistivity were established for both powder metallurgy processed wires. The reacted wires in the magnets gave upper limits of resistivity at 10 T of less than 1.4×10^{-14} Ω cm for the Nb_3Sn wire, and less than 9×10^{-13} Ω cm for the Nb-Al wire.

28797 Optical properties of diffusion-produced AuSn. Neel, S.; Arakawa, E.T.; Inagaki, T. (Health and Safety Research Division, Oak Ridge National Laboratory, Oak Ridge, Tennessee 37830). *Journal of Applied Physics;* **55**: No. 11, 4132-4133(1 Jun 1984). Contract W-7405-ENG-26.

Optical properties of the intermetallic compound AuSn were determined for photon energies between 0.6 and 2.9 eV by ellipsometry. The samples were made by interdiffusion in evaporated Au/Sn thin films at room temperature. The results obtained agree well with the results previously obtained for AuSn made by direct evaporation of a stoichiometric mixture of gold and tin.

28798 Spin dynamics near the magnetic percolation threshold. Aeppli, G.; Guggenheim, H.; Uemura, Y.J. (AT&T Bell Laboratories, Murray Hill, New Jersey 07974). *Physical Review Letters;* **52**: No. 11, 942-945(12 Mar 1984). Contract AC02-76CH00016.

An inelastic neutron-scattering study of spin relaxation in the dilute, two-dimensional Ising antiferromagnet Rb$_2$Co/sub c/Mg/sub 1-c/F$_4$ has been carried out for c very close to the magnetic percolation threshold c/sub p/ = 0.593. The dynamical exponent z relating the order-parameter relaxation rate to the magnetic correlation length is found to be 2.4/sub -0.1//sup +0.2/. It is argued that z has this anomalously high value because of the fractal geometry of percolating networks.

28799 Shock-wave experiments at threefold compression. Ragan, C.E. III. (Los Alamos National Laboratory, Los Alamos, New Mexico 87545). *Physical Review* [*Section*] *A: General Physics;* **29**: No. 3, 1391-1402(Mar 1984).

A high-pressure shock wave generated by an underground nuclear explosion was used to obtain precise Hugoniot data from impedance-matching measurements at pressures ranging from 1 to 6 TPa and corresponding to threefold compressions. The shock passed from a 180-mm-diam by 17.5-mm-thick lead driver into a 12-mm-thick molybdenum base plate and then into a central 12-mm-thick ^{238}U sample surrounded by stacks of the following pairs of 10-mm-thick samples (lower sample first): Mo-Pu (δ phase), W-Pb, Al—porous Mo (19% porosity), C-LiH, Cu-Au, and Fe-quartz (crystalline). Shock-front arrival-time measurements with 80 electrical-contact pins embedded in the assembly were used to determine shock velocities with uncertainties of 1.4—2.6 %; the shock front was found to be slightly curved (with a radius of curvature of ~2 m) but symmetric about the axis of the cylindrical driver with an upper limit on tilt asymmetry of 1.5 mrad. The measured shock velocity of 30.60 km/s in the molybdenum base plate corresponds to a pressure of 6.43 TPa based on the improved sesame equation of

state (EOS) for molybdenum. Impedance-matching analyses using the molybdenum base plate as the standard or reference material for the lower samples and using the lower samples as standards for the upper materials gave the following Hugoniot points in pressure (P) particle-velocity (u) coordinates for the indicated sample materials: Al(P = 2.93 TPa, u = 27.57 km/s), porous Mo(4.65, 19.99), C(2.64, 28.38), LiH(1.225, 35.52), Cu(6.06, 21.15), Fe(5.71, 21.73), and quartz(2.75, 26.76).

28800 **Corrosion of 316SS and IN800 in molten $NaNO_3$ - KNO_3.** Bradshaw, R.W. (Sandia National Laboratories, Livermore, California). *Proceedings - Electrochemical Society;* **83-1**: 455-471(Oct 1981). (CONF-811013—). Contract AC04-76DP00789.

From Electrochemical Society conference; Denver, CO, USA (11 Oct 1981).

The corrosion behavior of Type 316 stainless steel and Incoloy 800 in molten $NaNO_3$-KNO_3 was studied using thermal convection loops which operated between the temperature limits, 630°C-350°C, for up to 4000 hours. Corrosion rates were approximately 1 mil/year (2.5 x 10^{-2} mm/year) at 600°C for 316SS but increased to about 4 mil/year at 630°C. Less extensive results are reported for IN800, but the corrosion rates appear to be similar to 316SS. Corrosion products consisted of the spinels, Fe_3O_4 and $Fe(Fe,Cr)_2O_4$, at temperatures below 600°C, although $NaFeO_2$ and $Fe(Fe,Cr)_2O_4$ were present at higher temperatures. In addition, internal oxidation was observed in IN800. Considerable spalling of surface scales was found at temperatures above 600°C. Chromium, but not iron or nickel, accumulated as a solute in the melt as a result of depletion from the alloys, but no thermal gradient mass transfer was detected.

28801 **(LA-tr—83-24) Amorphization through irradiation with the fission fragments of a Pd-Si alloy.** Lesueur, D. Translated from *Radiation Effects ;* **24**: 101-110(1975). Contract W-7405-ENG-36. 25p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE84012557. DE84012557

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An experiment is described which allows one to distinguish the respective effects of atomic collisions and electronic excitation in the amorphization of a Pd-Si alloy by irradiation with fission fragments. It is shown that in such an alloy, where covalent bonding exists, electronic excitation induces a thermal spike which causes sputtering at the sample surface and, in the bulk, amorphization or local order modification. Atomic collisions also induce amorphization of this alloy. The volume thus amorphized includes not only displaced atoms but also their nearest neighbors as if breaking of some bonds leads to a local reordering of the atoms.

3602 Ceramics, Cermets, And Refractories

REFER ALSO TO CITATION(S) 27716, 28308

28802 **(CONF-8404110—5) Synthesis of submicron TiB_2 powders (1).** Brynestad, J.; Bamberger, C.E.; Heatherly, D.E.; Land, J.F. (Oak Ridge National Lab., TN (USA)). 1984. Contract AC05-84OR21400. 9p. NTIS, PC A02/MF A01; GPO Dep. Order Number DE84011629.

From 4. international conference on high temperature science - HYTHERM; Santa Fe, NM, USA (2 Apr 1984).

New methods for the synthesis of submicron TiB_2 powders have been found and experimentally demonstrated. The reactions 10 $TiCl_3$ (g) + 2 BCl_3 (g) (~ 1500°K or 900°K) → TiB_2 (s) + 9 $TiCl_4$ (g) and 2.5 Ti (s) + 2 BCl_3 (g) (>900°K) → TiB_2 (s) + 1.5 $TiCl_4$ (g), all can give submicron TiB_2 powders as end product. Some properties of these powders are discussed.

28803 **(DOE/ER/05111—T1) Microstructural studies of hydrogen and deuterium in bcc refractory metals. Final technical report .** Moss, S.C. (Houston Univ., TX (USA). Dept. of Physics). Apr 1984. Contract AS05-76ER05111. 13p. NTIS, PC A02/MF A01; GPO Dep. Order Number DE84011506.

Research was conducted on the microstructural atomic arrangements in alloys of hydrogen and deuterium with bcc refractory metals with emphasis on V and Nb. Because these are interstitial phases in which the host metal lattice is substantially deformed by the incorporation of the H(D) atoms, there are pronounced x-ray scattering effects. X-ray diffraction was used, with neutron scattering providing useful corollary data. One objective was to determine the phase relations, solid solution structures and phase transitions in metal-hydride alloys which depend upon the hydrogen-hydrogen interaction via the displacement field of the metal atoms. This has often included the elucidation of subtle thermodynamic properties (as in critical wetting) which are revealed in structural studies. Crystals were supplied for positron annihilation studies of the Fermi surface of H-Ta alloys which have revealed significant electronic trends. Work on alkali-graphite intercalates was initiated.

28804 (INIS-mf—8901, pp 22-26) **Surface states on ZrN and TiN.** Callenas, A.; Johansson, L.I. (Linkoeping Univ. (Sweden). Dept. of Physics and Measurement Technology); Inglesfield, J.E. (9050347GB). 1983. NTIS (US Sales Only), PC A14/MF A01. Order Number DE84701920. (CONF-830120—Exc.). TI84701920

From Symposium on surface science; Obertraun, Austria (30 Jan 1983).

Photoelectron energy spectra were measured at different incidence angles before and after CO exposures. Work function changes and the energy shift of the surface state of ZrN are calculated as a function of CO exposures. (G.Q.).

28805 **(IS-M—464) Phase equilibria and electrical conductivities in the HfO_2-Er_2O_3-Ta_2O_5 system.** Jordan, G.W.; Berard, M.F. (Ames Lab., IA (USA)). 1983. Contract W-7405-ENG-82. 26p. (CONF-8310175—4). NTIS, PC A03/MF A01; GPO Dep. Order Number DE84012838.

From 36. annual Pacific Coast Regional meeting of the American Ceramic Society; San Diego, CA, USA (3 Oct 1983).

This paper discusses phase equilibria and electrical conductivities in a ternary oxide alloy system based on Hf oxide. The limits of the single-phase fluorite structure and rare-earth-oxide C-type structure solid solutions in this system are reported, as are the total ac bulk electrical conductivities of several of the fluorite structure compositions for temperatures ranging from 500 to 1050°C and for oxygen partial pressures ranging from 1 to 10^{-20} atm.

28806 **(KFK—3374-B) Constitution, preparation, and properties of refractory compounds and systems (hard materials and hard metals).** Holleck, H.; Thuemmler, F. (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Inst. fuer Material- und Festkoerperforschung). 1983. 162p. (In German). NTIS (US Sales Only), PC A08/MF A01. Order Number DE84780152.

Individual items in scope for the data base are processed separately.

28807 **(PNL-SA—11881) Analytical characterization of coatings and thin overlayers.** Dahlgren, S.D.; Thomas, M.T.; Beauchamp, R.H.; Courtright, E.L. (Pacific Northwest Lab., Richland, WA (USA)). Mar 1984. Contract AC06-76RL01830. 23p. (CONF-8404135—2). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE84011902.

From International conference on metallurgical coatings; San Diego, CA, USA (9 Apr 1908).

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Recent coating characterization projects were selected as examples for demonstration of several modern coating characterization methods. X-ray Photoelectron Spectroscopy (XPS) revealed differences in chemistry and atomic bonding in two commercial TiN sputter deposits. Second, an enhanced laser Raman method of phase identification for Si_3N_4 was used to provide detail in thin film deposits not possible by x-ray diffraction methods. Third, internal stresses and microstructure obtained by transmission electron microscopy (TEM) of sputter deposited ZrO_2-8 mole % Y_2O_3 films were related to the parameters used during deposition. Lastly, an optical transmission method is shown to improve the resolution of a SiO_2 glass phase that had formed on sintered silicon carbide coatings during high temperature oxidation. 8 figures.

28808 **Optical phonons of aluminum nitride.** Carlone, C.; Lakin, K.M.; Shanks, H.R. (Ames Laboratory-USDOE, Iowa State University, Ames, Iowa 50011). *Journal of Applied Physics;* 55: No. 11, 4010-4014(1 Jun 1984). Contract W-7405-ENG-82.

Oriented polycrystalline films of AlN on Si(111) substrates and amorphous AlN films on sapphire substrates have been prepared by sputter deposition of aluminum in a nitrogen plasma. Phonons at 303, 426, 514, 614, 663, and 831 cm^{-1} (+- 3%) have been observed in the Raman spectra of the crystalline films. The 303-cm^{-1} phonon shifts to 288 cm^{-1} and the 663-cm^{-1} phonon to 650 cm^{-1} in the amorphous sample. By means of infrared absorption measurements with the electric field perpendicular to the c axis we have tentatively identified E_1(LO) and E_1(TO) modes near 800 and 610 cm^{-1}, respectively. A tentative assignment of the other modes is made from partial data from orientation dependent scattering and results for other wurtzite structure compounds. A comparison of the AlN phonon frequencies with those of other known wurtzite structure compounds shows that Martin's scaling equation is satisfied.

28809 **Structure-property correlations for TiB_2-based ceramics densified using active liquid metals.** Tennery, V.J.; Clark, G.W.; Finch, C.B.; Yust, C.S. (Structural Ceramics Group Metals and Ceramics Division Oak Ridge National Lab. Oak Ridge, TN). pp 891-909 of Science of Hard Materials. Viswanadham, R.K.; Gurland, J.; Rowcliffe, D.J. New York, NY; Plenum Publishing Corp. (1983). (CONF-810856—). Contract W-7405-ENG-26.

From International conference on the science of hard materials; Jackson, WY, USA (23 Aug 1981).

This chapter describes procedures for the fabrication of dense, crack-free TiB_2 ceramics. Discusses TiB_2 powder characterization; densification of TiB_2 ceramics; specimen preparation; structure and properties of TiB_2 ceramics; characterization procedures; microstructures; elastic and mechanical properties; hardness; thermal diffusivity; and behavior as metal cutting tools. Demonstrates that TiB_2 powders can be sintered to near theoretical densities using modest hot-pressing procedures when prescribed diboride particle sizes are used in conjunction with liquid sintering activation agents based on metals such as Ni. Finds that under optimum conditions, the TiB_2 particles maintain their original size, thereby avoiding the grain growth and microcracking characteristic of typical TiB ceramics.

28810 **Crystal chemistry and electron energy loss spectroscopy of titanium carbide precipitates in TiB_2.** Williams, W.S.; Allison, C.; Mochel, P. (Materials Research Lab. Univ. of Illinois at Urbana-Champaign Urbana, IL). pp 169-179 of Science of Hard Materials. Viswanadham, R.K.; Gurland, J.; Rowcliffe, D.J. New York, NY; Plenum Publishing Corp. (1983). (CONF-810856—). Contract AC02-76ER01198.

From International conference on the science of hard materials; Jackson, WY, USA (23 Aug 1981).

This chapter investigates TiB_2 crystals containing TiC precipitates. Describes the TiB_2 crystals used and optical studies of precipitates, gives the electron microscopy and diffraction results, describes electron energy loss spectroscopy and its application, mentions the crystallography of the matrix/precipitate relationship, reviews the thermochemistry of the system, and discusses the implications for cutting tools. Explains that the precipitates of transition metal carbides in borides and of borides in carbides form as a result of the thermodynamic stability of the two phases in contact and the crystallographic similarities of specific planes in each phase. Examines the practical implications of the precipitates for resisting plastic deformation of the matrix at high temperatures for the case of TiB_2 in TiC.

28811 **Alteration of surface properties by ion implantation.** McHargue, C.J.; Appleton, B.R.; Lewis, M.B.; Naramoto, H.; White, C.W.; Williams, J.M. (Metals and Ceramics Division Oak Ridge National Lab. Oak Ridge, TN). pp 451-465 of Science of Hard Materials. Viswanadham, R.K.; Gurland, J.; Rowcliffe, D.J. New York, NY; Plenum Publishing Corp. (1983). (CONF-810856—). Contract W-7405-ENG-26.

From International conference on the science of hard materials; Jackson, WY, USA (23 Aug 1981).

This chapter describes the use of ion implantation techniques to modify the mechanical properties of structural ceramics. Uses single crystalline Al_2O_3, single and polycrystalline α-SiC, and polycrystalline TiB_2. Demonstrates that ion implantation can be used to form both stable and non-equilibrium surface alloys on ceramics. Suggests that the amount of lattice damage is related to the degree of covalent bonding. Finds that the mechanical properties of Al_2O_3 and TiB_2 were increased by 20 to 60% by implantation. Points out that the alloy effects in Al_2O_3 were stable upon annealing to at least 1200°C whereas much of the implantation damage was removed at this temperature. The mechanical properties (microhardness and indentation fracture toughness) for α-SiC were unaltered.

28812 **Acid-base properties of ceramic powders.** Bleier, A. (Massachusetts Inst. of Technology 77 Massachusetts Ave., Room 12-011 Cambridge, MA 02139). pp 499-514 of Advances in materials characterization. Rossington, D.R.; Condrate, R.A.; Snyder, R.L. New York, NY; Plenum Publishing Corp. (1983). (CONF-820891—). Contract EX-76-A-01-2295.

From 18. ceramic science conference on advances in materials characterization; Alfred, NY, USA (16 Aug 1982).

This chapter addresses the fundamental aspects of potentiometric titration, electrokinetics, and conductometric titration in evaluating surface and interfacial thermodynamic behavior. Emphasizes the characterization of aqueous systems which are pertinent to the processing of ceramic powders. Attempts to clarify the role of novel analytical techniques that will increasingly contribute to the advanced characterization of ceramic powders. Evaluates recently developed acid-base and complexation concepts and their applications to the processing of oxide ceramics.

28813 **Erosion behavior of hard surface coatings/inserts.** Levy, A.V.; Bakker, T.W. (Lawrence Berkeley Lab. Materials and Molecular Research Division Berkeley, CA). pp 499-516 of Science of Hard Materials. Viswanadham, R.K.; Gurland, J.; Rowcliffe, D.J. New York, NY; Plenum Publishing Corp. (1983). (CONF-810856—). Contract W-7405-ENG-48.

From International conference on the science of hard materials; Jackson, WY, USA (23 Aug 1981).

This chapter attempts to determine the basic erosion behavior of several of the most promising refractory hard metal coatings and bodies that are currently either in development or commercial use. Discusses experimental conditions and metallographic analysis. Concludes that all of the materials tested eroded in a brittle manner, undergoing more erosion at a 90° impingement angle than a 30° angle; the CNTD SiC (hard) had the best erosion resistance; the coating materials had a peak erosion rate at the beginning of erosion; the amount of apparent plastic deformation that occurred in some of the materials can be related to the amount and condition of the metallic phases in the materials; and the large grain size near the coatingsubstrate interface of the CNTD SiC (hard) that eroded preferentially could be related to an instability in the deposition process that occurred near the initiation of deposition.

3603 Composite Materials

REFER ALSO TO CITATION(S) 29031

28814 **(UCID—20078) Quality-assurance tests of five Y-12 Kevlar-49 spools used to fabricate strands and reliability specimens for stress-rupture tests.** Caley, L.E.; Ambalal, P.K.; Carley, J.F.; Ford, T.S.; Moore, R.L.; Noecker, D.J.; Ross, M.E.; Sherry, R.J.; Yoshiyama, J.M. (Lawrence Livermore National Lab., CA (USA)). 7 May 1984. Contract W-7405-ENG-48. 63p. NTIS, PC A04/MF A01; GPO Dep. Order Number DE84012373.

An important component of the composite reliability program is the assurance of quality of Kevlar 49, 380-denier yarn and epoxy-impregnated yarn. This yarn, which is used in the fabrication of W-82 components from Kevlar 49/epoxy composites, is also formed into test specimens for long-term, stress-rupture studies and

reliability studies. The QA work covered in this report encompasses preparation of impregnated-yarn specimens, examination of the yarn itself and individual fibers therefrom, tensile testing of bare and impregnated yarns and heat-degraded yarns. The yarn samples were all drawn from spools of 380-denier Kevlar 49 shipped to LLNL from Y-12. The resin matrix is an amine-hardened epoxy with low viscosity and long pot life, intended for filament winding. The components are Dow epoxy resin (DER) 332 and Jeffamine T-403 triamine hardener. The stoichiometric combining ratio, which we used in our work, is 100 parts by weight resin to 44 parts hardener. Quality-assurance testing not only verifies that the yarns actually meet the manufacturer's specifications, but also provides data on the relationships between fiber characteristics and the lifetime reliability of fabricated items.

28815 **Characterization of TiB_2-Ni ceramics by transmission and analytical electron microscopy.** Sklad, P.S.; Yust, C.S. (Metals and Ceramics Division Oak Ridge National Lab. Oak Ridge, TN). pp 911-930 of Science of Hard Materials. Viswanadham, R.K.; Gurland, J.; Rowcliffe, D.J. New York, NY; Plenum Publishing Corp. (1983). (CONF-810856—). Contract W-7405-ENG-26.

From International conference on the science of hard materials; Jackson, WY, USA (23 Aug 1981).

This chapter examines a series of TiB_2-Ni ceramics fabricated using different TiB_2 powders. Determines that the amount of intergranular phase observed decreases as the mean particle size of the TiB_2 decreases, the excess initial nickel content being exuded from the compacts during hot pressing. Discusses sample preparation, optical microscopy, transmission electron microscopy (TEM), x-ray energy dispersive spectroscopy (EDS), convergent beam electron diffraction (CBED), electron energy loss spectroscopy (EELS), and phase relationships in the TiB_2-Ni system. Identifies the primary intergranular phase in the hotpressed TiB_2-Ni composites.

28816 **Effective thermal conductivity of glass-fiber board and blanket standard reference materials.** Smith, D.R.; Hust, J.G. (Thermophysical Properties Division National Bureau of Standards Boulder, CO 80303). pp 483-496 of Thermal conductivity. Hust, J.G. New York, NY; Plenum Publishing Corp. (1983). (CONF-8106164—).

From National Bureau of Standards joint conferences: 8. symposium on thermophysical properties; 17. thermal conductivity conference; 8. thermal expansion conference; Gaithersburg, MD, USA (15 Jun 1981).

This chapter reports on measurements of effective thermal conductivity performed on a series of specimens of glass-fiber board and glass-fiber blanket. Explains that measurements of thermal conductivity were conducted as a function of temperature from 85 to 360 K, of temperature difference with T=10 to 100 K, of bulk density from 11 to 148 kg/m^3 and for nitrogen, argon, and helium inter-fiber fill gases at pressures from atmospheric to high vacuum. Analyzes and compares results with values from the published literature and National Bureau of Standards (NBS) certification data for similar material. Gives polynomial expressions for the functional relation between conductivity, temperature, and density for board and for blanket.

28817 **Standardizing nonmetallic composite materials for cryogenic applications.** Kasen, M.B. (Fracture and Deformation Division National Bureau of Standards Boulder, CO 80302). pp 327-337 of Nonmetallic materials and composites at low temperatures. Hartwig, G.; Evans, D. New York, NY; Plenum Publishing Corp. (1982). (CONF-8008169—).

From 2. ICMC symposium on nonmetallic materials and composites at low temperatures; Geneva, Switzerland (4 Sep 1980).

This chapter examines the inability to associate reliably the cryogenic performance required for diverse applications with the profusion of products identified by trade names, most of which were developed for other purposes. Emphasizes that the immediate task is to assist designers and fabricators in the selection of dependable insulating and structural nonmetallic laminates for magnetic fusion energy (MFE) and magnetohydrodynamic (MHD) systems presently being built in the US. Discusses the ongoing efforts in the US to provide a commercial supply of specific controlled-performance laminates required to meet the short-term needs of the cryogenic industry.

28818 **The strain energy release rate of glass fiber-reinforced polyester composite.** Han, K.S.; Koutsky, J. (University of Wisconsin Madison, WI). pp 213-229 of Nonmetallic materials and composites at low temperatures. Hartwig, G.; Evans, D. New York, NY; Plenum Publishing Corp. (1982). (CONF-8008169—).

From 2. ICMC symposium on nonmetallic materials and composites at low temperatures; Geneva, Switzerland (4 Sep 1980).

This chapter reports on the fracture energy of a glass fiber polyester composite. Examines the width tapered double cantilever beam and its application for the measurement of fracture energy at 300K and 77K. Finds that crack propagation is dependent on the glass fiber direction; the optimum taper is 3 and the minimum thickness is 1/2"; the specimen behaves viscoelastically; hysteresis is a function of taper, thickness and crack length; the fracture energy transverse to the fiber direction is slightly higher than along the fiber direction; and fracture energy at 77K (2200 J/m^2) is higher than at 300K (774 J/m^2), suggesting that glass fiber-reinforced polyester composite can be used successfully at a cryogenic temperature

3604 Polymers And Plastics

REFER ALSO TO CITATION(S) 27949, 27949, 28442

28819 **(EGG-M—21683) Use of surface and thin film analysis techniques to study metal-organic and metal-polymer interaction.** Tompkins, H.G. (EG and G Idaho, Inc., Idaho Falls (USA)). 1984. Contract AC07-76ID01570. 27p. (CONF-8404135—3). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE84012542.

From International conference on metallurgical coatings; San Diego, CA, USA (9 Apr 1908).

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Very thin organic or polymer films can be analyzed using several analytic techniques. The thickness of the films discussed ranges from monolayers to several thousand angstroms thick. The techniques described are x-ray photoelectron spectroscopy, infrared spectroscopy, ellipsometry, and the quartz crystal oscillator microbalance. The latter technique is applied to a fluoropolymer deposited on a silver surface. The parameters which control film thickness and uniformity are discussed along with how one measures these parameters. The second example discussed is the application of nitrogen containing organic molecules to copper and iron surfaces. The chemical bonding is discussed along with the orientation of the molecules in the resulting film and the analytical techniques used.

28820 (INIS-mf—8921, pp 28) **Picosecond phenomena in polyacetylene.** Vardeny, Z. (Technion-Israel Inst. of Tech., Haifa. Dept. of Physics); Moses, D.; Heeger, A.J. (California Univ., Santa Barbara (USA). Dept. of Physics). 1983. NTIS (US Sales Only), PC A05/MF A01. Order Number DE84780235. (CONF-8303128—Summ.). TI84780235

From Israel Physical Society annual meeting; Ramat-Gan, Israel (24 Mar 1983).

28821 (INP—1080/PL, pp 111-115) **NMR study of the orientation of macromolecules in drawn polypropylene films.** Murin, J.; Olcak, D.; Rakos, M. (Vysoka Skola Technicka, Kosice (Czechoslovakia)); Simo, R. (Research Institute of Chemical Fibres, Svit (CSSR)). 1980. NTIS (US Sales Only), PC A13/MF A01. Order Number DE84780233. (CONF-791295—). TI84780233

From 12. national seminar on nuclear magnetic resonance and its applications; Cracow, Poland (3 Dec 1979).

The results of NMR study of the orientation of the macromolecular chains in the undrawn and drawn (uniaxially) films made of the isotactic polypropylene are given. The angular dependences of the second moments are presented.

28822 (UCID—20082) Study of insoluble crystals derived from solutions of Kevlar 49 in sulfuric acid. Butler, N.L. (Lawrence Livermore National Lab., CA (USA)). 21 May 1984. Contract W-7405-ENG-48. 17p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE84012226.

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The object of the study was to isolate and obtain x-ray diffraction analysis of the insoluble crystals which have been observed in Kevlar 49/H_2SO_4 dope. These insoluble crystals had previously been reported to be Kevlar single crystals after analysis by optical microscopy. A more detailed analysis does not support this conclusion. Additional optical microscopy coupled with FTIR and elemental analysis for C, H and N, has shown that these insoluble crystals are in fact terephthalic acid which is a decomposition product of the acid hydrolysis of Kevlar. A model compound study of sulfuric-acid hydrolysis of aromatic amide was carried out in order to better understand the sulfuric-acid-hydrolysis of Kevlar.

28823 Bis(pentamethylcyclopentadienyl)ytterbium(II) as a Lewis acid and electron-transfer ligand: preparation and crystal structures of [Yb(Me_5C_5)$_2$(μ-CO)/sub x/Mn(CO)/sub 5-x/]/sub y/ (x,y = 2; x = 3, y = ∞). Boncella, J.M.; Andersen, R.A. (Univ. of California, Berkeley). *Inorganic Chemistry;* **23**: No. 4, 432-437(15 Feb 1984). Contract AC03-76SF00098.

The divalent ytterbium metallocene (Me_5C_5)$_2$Yb(OEt_2) reacts with $Mn_2(CO)_{10}$ to give a compound of composition (Me_5C_5)$_2$YbMn(CO)$_5$ $^1/_4$PhMe, which was shown by an X-ray crystallographic study to be composed of a polymeric chain of [(Me_5C_5)$_2$Yb(μ-OC)$_2$Mn(CO)$_3$] units with dimeric units [(Me_5C_5)$_2$Yb(μ-OC)$_2$Mn(CO)$_3$] packed between the polymeric sheets. The toluene of solvation fills regularly spaced voids in the network of dimer and polymer sheets. The space group is C2/m with a = 18.942 (5) A, b = 32.592 (5) A, c = 19.029 (5) A, β = 109.92 (2)^0, V = 11045 (18) A^3, and Z = 16. The contact-ion-pair complex results from (Me_5C_5)$_2$Yb acting as an electron-transfer reagent, (Me_5C_5)Yb$\rightarrow$(Me_5C_5)$_2$Yb$^+$ + le$^-$, and as a Lewis acid by way of Yb(μ-OC)Mn interactions. The solution and solid-state infrared spectra are discussed relative to the alkali-metal analogues. The rhenium carbonyl $Re_2(CO_{10}$ behaves similarly.

3606 Other Materials

REFER ALSO TO CITATION(S) 27964, 27965, 27967, 28074, 28079, 28089, 28731, 29041, 29884

28824 (CEA-CONF—6979) Application of a global plasticity model to determine the ultimate strength of a reinforced concrete slab. Hoffmann, A.; Millard, A.; Nahas, G. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France)). Aug 1983. 17p. (CONF-830805—89). NTIS (US Sales Only), PC A02/MF A01. Order Number DE84750670.

From 7. international conference on structural mechanics in reactor technology; Chicago, IL, USA (22 Aug 1983).

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In order to predict the behaviour of composite beams and shells loaded up to failure, a global method has been developed. This method is based on a generalized stress approach, formulated in terms of moment-curvature relations. The case of a reinforced concrete slab subjected to uniform pressure has been considered. It is shown that numerical results compare fairly well with experimental data. Some improvements to the model are also suggested.

28825 (CEA-CONF—6982) Calculations of concrete containment tight loss: studies of a reinforced concrete SLAB with non uniform thickness. Jamet, P. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France)). Aug 1983. 12p. (CONF-830805—79). NTIS (US Sales Only), PC A02/MF A01. Order Number DE84750631.

From 7. international conference on structural mechanics in reactor technology; Chicago, IL, USA (22 Aug 1983).

A study was carried out in order to investigate the validity of a concrete model including tensile fracture and strain-softening under compressive loading. Triaxial tests were performed on micro-concrete specimens, and the post-peak behaviour of the material was characterized. The parameters required by the model were therefore obtained. The case of a circular slab loaded up to failure was then considered, in order to compare the numerical results obtained by a finite elements analysis including the concrete model, to the experimental data.

28826 (CEA-CONF—6983) Perforation of a concrete slab by a missile: finite element approach. Jamet, P.; Berriaud, C.; Millard, A.; Nahas, G.; Yuritzin, T. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France)). Aug 1983. 11p. (CONF-830805—83). NTIS (US Sales Only), PC A02/MF A01. Order Number DE84750638.

From 7. international conference on structural mechanics in reactor technology; Chicago, IL, USA (22 Aug 1983).

A specific concrete model has been developed to investigate the problem of concrete walls perforation by a missile: three types of damage are accounted for: traction damage, shear damage, hydrostatic pressure damage. In order to investigate the validity of this concrete model in simple compressive conditions, tests are performed in following configuration: microconcrete used in perforation tests is cast in a cylindrical mould 100 mm diameter, 50 mm wall thickness made of very strong steel. The concrete height is 400 mm. A silver layer is put on the inner face to decrease the friction coefficient. The load is transmitted to the concrete by means of a metal piston. A quasi static test is first performed using a hydraulic testing machine. A second one is then impacted by a 32 kg mass dropping from 19 meters. In both cases the displacement and the forces are recorded for comparison with calculation.

28827 (CEA-CONF—7005) Oxygen precipitation on CZ silicon dislocations: thermodynamic analysis and stability. Bourret, A. (CEA Centre d'Etudes Nucleaires de Grenoble, 38 (France)). Mar 1983. 6p. (In French). (CONF-8303122—1). NTIS (US Sales Only), PC A02/MF A01. Order Number DE84750674.

From Congress on dislocation structure and properties in semiconductors; Aussois, France (7 Mar 1983).

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The existence of a metastable cylinder of cristalline SiO_2 along the dislocation core is explained using a thermodynamical approach. Its radius given by a minimum in the total free energy of the system is relatively independent of the chemical free energy change but strongly dependent on the Burgers vector. It is shown that this cylindrical embryo still exists for moderatly undersaturated solution. Comparison with experimental values gives a Si/coesite interface energy equal to 140 ergs/cm^2. These cylinders were clearly observed at b= [100] and 1/3 [111] dislocations. For other dislocations the radius is comparable or smaller than the dislocation core size.

28828 (CONF-840403—4) Particle contamination in gas-insulated systems: new control methods and optimum SF_6/N_2 mixtures. Pace, M.O.; Adcock, J.L.; Christophorou, L.G. (Oak Ridge National Lab., TN (USA); Tennessee Univ., Knoxville (USA)). 3 May 1984. Contract AC05-84OR21400. 8p. NTIS, PC A02/MF A01; GPO Dep. Order Number DE84011670.

From 4. international symposium on gaseous dielectrics; Knoxville, TN, USA (29 Apr 1984).

The feasibilities of two new separate techniques to control particle contamination in practical gas-insulated sytems were tested in a small-scale concentric cylinder geometry. In one technique an insulating coating was first formed on the particles in a contaminated system by low-pressure discharges in appropriate gases such as 1-C_3F_6 and c-C_4F_8. When SF_6 was subsequently introduced into the same system at practical pressure as the operating insulation, the considerable harm ordinarily caused by particles was found to be eliminated. The nature of the coating formed also on the electrodes in this process was studied, with the conclusion that the observed benefits were primarily due to coating on particles, not on electrodes. In the second technique the particles, moved randomly by electrical stress, struck and adhered to the surface of a tacky insulating solid material; they were subsequently encapsulated in a melt-resolidify cycle without electrical stress. This trapping technique

was also found to eliminate the harmful effects of particles in SF_6 at practical pressure. A technique for producing a trapping material with temperature characteristics appropriate for practical apparatus was devised. The effect of particle contamination on the dielectric strength of SF_6/N_2 mixtures was studied as a function of total pressure and percentage of each gas. Optimum total pressure (~ 6 atm) and optimum percentages (60% SF_6/40% N_2) were observed in breakdown tests in particle-contaminated concentric cylinder geometry.

28829 **(IC—83/23) Generalized linear response functions.** Obada, A.S.F.; Abu-Sitta, A.M.M.; Faramawy, F.K. (International Centre for Theoretical Physics, Trieste (Italy)). Feb 1983. 54p. NTIS (US Sales Only), PC A04/MF A01. Order Number DE84701676.

To discuss the response of a system to an electromagnetic field the minimal coupling Hamiltonian is assumed. The quadratic term in the potential is kept. The Kubo formalism for perturbation is applied and perturbations to all orders in the internal fields are considered. However only the first-order perturbation for the external probe is taken. Thus the linear response function is calculated. The inclusion of the quadratic term contributes terms to this function. Due to these terms the Dyson-like propagator equation is corrected. This equation is developed to obtain the different susceptibilities. It is found that the contributions from the density-current and current-current propagators must be taken into account, in addition to the density-density propagator, when the polarizability is considered to obtain the correct result. The polarizability of the system is then calculated in two approximations. When the quadrupole contribution is considered, the number of the propagators increases. They are given through a coupled set of generalized Dyson-like equations. The different fields are defined and discussed and the interplay between them is manifested. The simplest coupled set is considered and developed to give two coupled integral equations in an extension to the classical integral equation for the electric polarization field. They are solved for a finite crystal and the refractive index is calculated for the propagating waves when the probing field is light. The phenomena of birefringence and optical rotation are discussed through simplified models. The extension theorem is found to hold in a generalized form. Hence the dependence on the geometry of the system is discussed. The effects of the quadrupole terms on these phenomena are shown and discussed. Some other optical phenomena and the higher multipole contributions are briefly discussed.

28830 (INIS-mf—8921, pp 23) **Studies of metal-InP interfaces.** Shapira, Y. (Tel Aviv Univ. (Israel). Dept. of Engineering Sciences); Brillson, L.J. (Xerox Corp., Webster, NY (USA). Webster Research Center). 1983. NTIS (US Sales Only), PC A05/MF A01. Order Number DE84780235. (CONF-8303128—Summ.). TI84780235

From Israel Physical Society annual meeting; Ramat-Gan, Israel (24 Mar 1983).

28831 (INIS-SU—203, pp 58-61) **Spectra of primary displaced atoms in semiconductor caused by cosmic-ray protons.** Mironov, Yu.A. (Moskovskij Inzhenerno-Fizicheskij Inst. (USSR)). 1982. (In Russian). NTIS (US Sales Only), PC A06/MF A01. Order Number DE84780155. TI84780155

In Radiation damage physics and radiation technology.

Energy spectra of primarily displaced atoms of silicon and germanium from 0.66-3.2 GeV protons, that are typical of the galactic radiation, have been calculated taking into account elastic and inelastic scattering. In the calculations of the inelastic scattering, an effective energy averaged over the nuclear masses and corrected for the probability of the nucleus-induced displacements has been introduced. This allowed one to avoid a double differential distribution. The derived results offer the possibility of simulating the radiation effects on semiconductor devices designed for operating in space.

28832 (INIS-SU—203, pp 62-63) **Influence of implantation conditions on defect formation in silicon.** Stel'makh, V.F.; Tolstykh, V.P. (Belorusskij Gosudarstvennyj Univ., Minsk). 1982. (In Russian). NTIS (US Sales Only), PC A06/MF A01. Order Number DE84780155. TI84780155

In Radiation damage physics and radiation technology.

The influence of P^+ and Ar^+ ion current density and the target temperature (Tsub(i)) on the generation and annealing of radiation defects in silicon has been studied by the electron paramagnetic resonance method. Besides the defects connected with amorphous silicon, the Si-P1 center has been observed at Tsub(i)>370 K. The Si-P1 center is supposed to be the primary defect having paramagnetic and diamagnetic states. The increase of the ion current density at Tsub(i) > 370 K leads to the enhancement of annealing processes and the decrease of concentrations of stable paramagnetic centers.

28833 (INIS-SU—203, pp 71-73) **Gamma radiation effect on n-InP crystals with impurity clusters.** Vitovskij, N.A.; Dakhno, A.N.; Emel'yanenko, O.V.; Lagunova, T.S.; Mashovets, T.V. (AN SSSR, Leningrad. Fiziko-Tekhnicheskij Inst.). 1982. (In Russian). NTIS (US Sales Only), PC A06/MF A01. Order Number DE84780155. TI84780155

In Radiation damage physics and radiation technology.

Parameters of acceptor-impurity atom clusters have been investigated for the cases of nonirradiated and gamma-irradiated n-InP crystals. Temperature dependences of electric conductivity, the Hall coefficient and the longitudinal magnetoresistance have been measured both in darkness and in lighting, the kinetics of the photoconductivity drop has also been studied. It is shown that in nonirradiated n-InP:Cu and n-InP-Zn the number of atoms in the cluster may be about 25-30. The concentration of the clusters may reach 10^{11} cm^{-3}. Gamma-radiation increases the number of atoms in the cluster up to approximately equal to 40 with the insignificant change of the radius. In the nonirradiated material, the potential barrier heights created by the cluster are 0.15 eV and 0.4 eV at 78 and 300 K, respectively. The irradiation increases the barrier and the fraction of the volume occupied by the space-charge regions which overlap if the dose is sufficiently high.

28834 (INIS-SU—203, pp 64-68) **Defect formation in $MgOxnAl_2O_3$ at gamma-neutron irradiation.** Gritsyna, V.T.; Dobrovinskaya, E.R.; Kobyakov, V.A.; Kol'ner, V.B.; Reznik, S.I. (Khar'kovskij Gosudarstvennyj Univ. (Ukrainian SSR)). 1982. (In Russian). NTIS (US Sales Only), PC A06/MF A01. Order Number DE84780155. TI84780155

In Radiation damage physics and radiation technology.

Optical and mechanical characteristics of spinel crystals after reactor irradiation are investigated. The comparison of the concentrations of radiation-induced anion vacancies and stable F-centers has shown that less than one tenth of the point defects is stabilized at room temperature. The annealing of these vacancies occurs at 800 K. The vacancy formation during gamma-neutron irradiation of nominally pure spinel crystals improves the crack resistance. The irradiation of Fe- and Mn ion-doped crystals $MgOxnAl_2O_3$, is accompanied by the coagulation stresses and crack resistance decrease.

28835 **(LBL—17520) Laboratory hydraulic fracturing stress measurements in salt.** Boyce, G.M.; Doe, T.W.; Majer, E. (Lawrence Berkeley Lab., CA (USA)). Mar 1984. Contract AC03-76SF00098. 10p. (CONF-840633—11). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE84010783.

From 25. US symposium on rock mechanics; Evanston, IL, USA (25 Jun 1984).

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This paper discusses the results of a laboratory testing program to determine the validity of hydraulic fracturing stress measurements in salt. Tests were performed on 15 cm diameter samples loaded under hydrostatic stress conditions to determine the influence of time, confining pressure, flow rate, borehole diameter, and packers on breakdown pressure. Tests were also performed in a polyaxial loading frame to determine whether or not hydraulic fracturing could be used to measure non-hydrostatic stresses. The test results indicate that the breakdown pressure is not affected by time delays of up to 64 hours between the application of load fracturing the rock. Breakdown pressures were found to fall short of predicted elastic values at higher confining pressures for the hydrostatic tests. The ratio of the horizontal stresses in non-hydrostatic tests had no effect on breakdown pressures. Flow rate and borehole di-

ameter variations were found to have a marked effect on breakdown pressures. Shut-in pressure value, exceeded the applied minimum stresses by 10 to 60% depending on the method of determination used. The lack of a relationship between breakdown pressure and horizontal stress ratio may preclude hydraulic fracturing from being used in salt as it is conventionally applied in brittle rocks. 10 references, 4 figures.

28836 **(SAND—83-1948C) Preparation of barium titanate films using sol-gel techniques.** Dosch, R.G. (Sandia National Labs., Albuquerque, NM (USA)). 1984. Contract AC04-76DP00789. 5p. (CONF-840288—2). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE84011256.

From Symposium on better ceramics through chemistry; Albuquerque, NM, USA (27 Feb 1984).

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Sol-gel techniques provide a convenient method of applying barium titanate films on solid substrates at ambient temperature. A significant advantage in using this technique is the capability of maintaining compositional homogeneity while coating large areas of surfaces with complex geometries. Solutions prepared by reacting a titanium alkoxide with barium hydroxide in methanol were used for preparing thin films (1000 to 3000A) of barium titanate on silicon and metal substrates. Electrical properties of the films depended both on solution parameters and subsequent heat treatment of the films. Highest field strengths (8-9 x 10^6V/cm) were observed in amorphous films prepared from partially hydrolyzed solutions.

28837 **(UCID—20077) Mechanical strength properties of gypsum/aggregate mixtures for applications in stemming design.** Kusubov, A.S.; Anderson, G.D. (Lawrence Livermore National Lab., CA (USA)). Feb 1984. Contract W-7405-ENG-48. 16p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE84012141.

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A series of stress-strain tests was performed on a mixture of gypsum cement and tuff aggregate used as a stemming material for emplacement holes in underground nuclear testing. Purpose was to evaluate the failure strength of the stemming material as a function of pressure. The material was tested at confining pressures ranging up to 3000 psi at a strain rate of $10^{-4}s^{-1}$, and in an unconfined state at strain rates of 10^{-4} s^{-1} and 10^{-1} s^{-1}. In the tests at low strain rates, the strength increased from a range of about 1000 to 1500 psi unconfined to about 6000 to 8000 psi at 2000-psi confinement. The unconfined material was generally somewhat weaker at a strain rate of 10^{-1} s^{-1} than at 10^{-4} s^{-1}. Strength also decreased with increasing moisture at low strain rate, but no trend could be discerned at the higher strain rate.

28838 **(UCRL—52000-84-4) Energy and technology review.** (Lawrence Livermore National Lab., CA (USA)). Apr 1984. Contract W-7405-ENG-48. 50p. NTIS, PC A03/MF A01; GPO Dep. Order Number DE84011623.

Research activities at Lawrence Livermore Laboratory are described. These include: studies of the strength of ice; first principles calculations of the properties of materials; manufacturing of silicone cushions for engineering applications; and a study of economic development in the Livermore Valley. (GHT)

28839 **(UCRL—89872) Recent damage results for antireflection coatings at 355 nm.** Hart, T.T.; Carniglia, C.K.; Rainer, F.; Staggs, M.C. (Optical Coating Lab., Inc., Santa Rosa, CA (USA); Lawrence Livermore National Lab., CA (USA)). 1 Mar 1984. Contract W-7405-ENG-48. 8p. (CONF-8311146—4). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE84011560.

From Symposium on optical materials for high power lasers; Boulder, CO, USA (14 Nov 1983).

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High-index and low-index thin-film antireflection (AR) coatings for use at 355 nm have been tested to determine their resistance to laser damage. All coatings consisted of dielectric materials which were vacuum deposited onto bowl-feed polished Suprasil II by evaporation. Laser damage studies were made by irradiating several sites on each sample with a 0.6 ns, 355 nm laser pulse. Each site was irradiated by only one pulse. High-index coatings were made with both a high-index material and a low-index material. The high-index materials chosen for this study were scandia (Sc_2O_3), hafnia (HfO_2), and zirconia (ZrO_2), while the low-index materials were silica (SiO_2) and magnesium fluoride (MgF_2). All coatings had four non-quarterwave thick layers plus a halfwave-thick undercoat (barrier layer) of the low-index material. Average damage threshold values for four samples of each type ranged from 2.4 J/sq cm to 3.1 J/sq cm. Coatings made from scandia/magnesium fluoride had the highest damage thresholds. Low-index coatings contained only low-index materials. The low-index materials chosen for this study were samarium fluoride (SmF_3), lanthanum fluoride (LaF_3) thorium fluoride (ThF_4), silica, magnesium fluoride, and lithium fluoride (LiF). AR coatings containing three to six quarter-wave-thick layers plus a halfwave-thick barrier layers were made from nine combinations of these six materials. Average damage threshold values for four to six samples of each type ranged from <1.0 J/sq cm to 2.8 J/sq cm. Coatings made from samarium fluoride/magnesium fluoride had the highest damage thresholds. One set of four scandia/silica coatings was measured at both 355 nm and 248 nm. Damage thresholds at 248 nm for these parts were determined using 20 ns laser pulses. The average threshold was 4.2 J/sq cm.

28840 **(UCRL—90725) Thermal conductivity of Permian Basin bedded salt at elevated pressure.** Durham, W.B.; Boro, C.O.; Beiriger, J.M. (Lawrence Livermore National Lab., CA (USA)). Apr 1984. Contract W-7405-ENG-48. 13p. (CONF-8310163—11). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE84011312.

From 18. international thermal conductivity conference; Rapid City, SD, USA (3 Oct 1983).

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Measurements of thermal conductivity were made on five core samples of bedded rock salt from the Permian Basin in Texas. The sample size was 100 mm in diameter by 250 mm in length. Measurements were conducted under confining pressures ranging from 3.8 to 31.0 MPa and temperatures from room temperature to 473 K. Conductivity showed no dependence on confining pressure, but showed a monotonic, negative temperature dependence. Four of the five samples showed conductivities clustered in a range of 5.6 +- 0.5 W/m.K at room temperature, falling to 3.6 +- 0.3 W/m.K at 473 K. These values are approximately 20% below the values for pure halite, reflecting perhaps the 5 to 20% non-halite component of the samples. The fifth sample showed a conductivity vs temperature dependence much like that of halite. 19 references, 4 figures.

28841 **Be-implantation doping of GaAs/sub x/P/sub 1-x//GaP strained-layer superlattices.** Myers, D.R.; Biefeld, R.M.; Fritz, I.J.; Picraux, S.T.; Zipperian, T.E. (Sandia National Laboratories, P. O. Box 5800, Albuquerque, New Mexico 87185). *Applied Physics Letters;* **44**: No. 11, 1052-1054(1 Jun 1984). Contract AC04-76DP00789.

We present Hall-effect measurements of the first localized p-type doping in GaAs/sub x/P/sub 1-x/ /GaP strained-layer superlattices achieved by implantation of 1 x 10^{15} cm^{-2}, 75 kV $^9Be^+$ followed by controlled-atmosphere annealing at 825 °C for 10 min. The acceptor activation (~15% at 300 K) and the mobilities in the p regions (~20 cm^2/Vs at 300 K) are consistent with the values expected for type-converted GaP-based alloys. Depth-dependent structural characterization by ion channeling demonstrates that the superlattice structure survived the implantation and annealing without loss of layer strain. These results demonstrate that Be implantation can be applied to produce localized doping in a strained-layer superlattice system and reflect favorably on the stability of strained-layer superlattices under particle bombardment and thermal cycling.

28842 **Pulsed soft x-ray response of InP:Fe photoconductors.** Kania, D.R.; Bartlett, R.J.; Wagner, R.S.; Hammond, R.B.; Pianetta, P. (Los Alamos National Laboratory, Los Alamos, New Mexico 87545). *Applied Physics Letters;* **44**: No. 11, 1059-1061(1 Jun 1984).

We report measurements of the energy-dependent pulse response of InP:Fe photoconductors to soft x rays in the energy range 200 eV—3 keV. The experiments were performed with x-ray

pulses from the Stanford Positron Electron Asymmetric Ring storage ring at the Stanford Synchrotron Radiation Laboratory. The detector had an optical impulse response of 180 ps (full width at half-maximum) and an active area of 1 x 1 mm. An array of filters (carbon, magnesium, and beryllium) was used to unfold the energy response of the detector to the soft x rays. Direct measurements of the time structure of the ring bunches were limited by the bandwidth of the real time recording system (400 MHz), but inidividual ring pulses were easily recorded with a detector pulse amplitude of 65 mV for the unfiltered beam. The detector response was constant over the energy range examined at 2.7×10^{-3} A/W.

28843 **Internal friction changes in NaCl at 77 K.** Bielig, G.A. (Physics Department, James Cook University, James Cook University Post Office, Townsville, Queensland, Australia 4811). *Journal of Applied Physics;* **55**: No. 11, 4123-4124(1 Jun 1984).

The behavior of B/B_0, the fractional change in the dislocation damping coefficient, has been studied at 77 K for continuous and interrupted radiation experiments using λ rays. Preliminary results indicate that B shows similar increases as observed at room temperature, but there appears to be a decreasing component of B/B_0 when the radiation is first switched on. Illumination with laser light (λ = 633 nm) tends to "erase" previous B/B_0 changes as well as unpinning dislocations.

28844 **Vibrational spectra of chemisorbed molecular clusters: H_2O on Ru(001).** Thiel, P.A.; DePaola, R.A.; Hoffmann, F.M. (Department of Chemistry and Ames Laboratory, Iowa State University, Ames, Iowa 50011). *Journal of Chemical Physics;* **80**: No. 10, 5326-5331(15 May 1984).

Electron energy loss spectroscopy and thermal desorption mass spectroscopy have been used to correlate vibrational spectra of H_2O on Ru(001) with ESDIAD patterns reported recently. We find that the "extended bilayer" is characterized by a sharp fundamental O—H vibration at 3500—3565 cm^{-1} which is assigned to nonhydrogen-bonded OH bonds of molecularly adsorbed water. Hydrogen bonds within the well-ordered bilayer give rise to features at ~3290—3450 cm^{-1} which are of relatively weak intensity in electron scattering due to the orientations of these bonds. In addition, very small clusters exhibit a weak vibrational mode at ~2935 cm^{-1} which possibly represents H_2O molecules with one O—H bond pointing into the surface. Isolated H_2O molecules at low temperature and low coverage exhibit a fundamental O—H vibration at 3600 cm^{-1}. A reinterpretation of the thermal desorption spectra is suggested.

28845 **Independence of Fermi-level position and valence-band edge discontinuity at GaAs-Ge(100) interfaces.** Chiaradia, P.; Katnani, A.D.; Sang, H.W. Jr.; Bauer, R.S. (Xerox Palo Alto Research Center, Palo Alto, California 94304). *Physical Review Letters;* **52**: No. 14, 1246-1249(2 Apr 1984).

The valence-band discontinuity, ΔE/sub v/, and the Fermi-level position, E/sub F/, at GaAs-Ge(100) heterojunctions are investigated by synchrotron radiation photoemission for variations in GaAs surface As and ambient As_4 during molecular-beam epitaxial growth. E/sub F/ can be varied by 0.35 eV at the interface, and its position is uncorrelated with the constant 0.46 +- 0.05 eV measured for ΔE/sub v/. These results are not consistent with a defect model for heterojunction barrier heights.

28846 **Silicone cushions for engineering applications.** *Energy Technology Review;* 34-41(Apr 1984).

When a complex system composed of materials of very different properties is subjected to varying temperature, differential thermal expansion and contraction will produce intolerable stresses unless the parts are separated by suitable cushions. In addition to accommodating differential thermal expansion and contraction, these cushions must absorb shock and vibration, take up dimensional tolerances in the parts, and distribute and attenuate applied loads. We are studying cellular silicone cushions, starting with raw materials and polymer manufacture, to analysis of mechanical and chemical properties, through short- and long-term life testing, in order to tailor cushions to various specific engineering requirements.

28847 **Direct measurement of the polarization dependence of Si(111)2 x 1 surface-state absorption by use of photothermal displacement spectroscopy.** Olmstead, M.A.; Amer, N.M. (Applied Physics and Laser Spectroscopy Group, Lawrence Berkeley Laboratory, University of California, Berkeley, California 94720). *Physical Review Letters;* **52**: No. 13, 1148-1151(26 Mar 1984). Contract AC03-76SF00098.

The polarization dependence of midgap optical absorption (0.38—0.51 eV) by Si(111)2 x 1 single-domain surfaces has been measured directly by photothermal displacement spectroscopy. The absorption is strongest when the light is polarized perpendicular to the period-doubling direction of the 2 x 1 reconstruction and is reduced by at least 95% when the polarization is rotated by 90°. This result supports the π-bonded chain model of the Si(111)2 x 1 surface reconstruction.

28848 **Momentum density of hcp ^{4}He.** Hilleke, R.O.; Chaddah, P.; Simmons, R.O.; Price, D.L.; Sinha, S.K. (Department of Physics and Materials Research Laboratory, University of Illinois at Urbana-Champaign, Urbana, Illinois 61801). *Physical Review Letters;* **52**: No. 10, 847-850(5 Mar 1984). Contract AC02-76ER01198.

The momentum density of the quantum solid hcp ^{4}He has been measured at 1.70 K at the molar volumes 18.20 and 19.45 cm^3. The measurements were made with pulsed incident neutrons of energy 505 meV, and with momentum transfers in the range of 12 to 22.5 A^{-1}. The momentum density is obtained from the inelastic-scattering spectrum at each of eight scattering angles. The measured distribution is Gaussian and the derived kinetic energies are larger than proposed by existing theories.

28849 **Cross-sectional transmission electron microscopy of semiconductors.** Sadana, D.K. (Dept. of Materials Science and Mineral Eng., Lawrence Berkeley Lab. Univ. of California, Berkeley, CA 94720). pp 359-365 of Advances in materials characterization. Rossington, D.R.; Condrate, R.A.; Snyder, R.L. New York, NY; Plenum Publishing Corp. (1983). (CONF-820891—). Contract AC03-76SF00098.

From 18. ceramic science conference on advances in materials characterization; Alfred, NY, USA (16 Aug 1982).

This chapter describes a method to prepare cross-sectional (X) semiconductor specimens for transmission electron microscopy (TEM). Demonstrates the power and utility of cross-sectional TEM (XTEM). Discusses the preparation technique for crosssection specimens, and structural defects profiles from XTEM and other techniques (e.g., TEM/SIMS). Shows that accuracy and interpretation of indirect structural-defects profiling techniques, namely, MeV He^+ channeling and secondary ion mass spectrometry (SIMS) can be greatly enhanced by comparing their results with those obtained by XTEM from the same set of samples.

28850 **A study of water in glass by an autoradiographic method that utilizes tritiated water.** Knickerbocker, S.H.; Brown, S.D.; Joshi, S.B. (Univ. of Illinois at Urbana-Champaign Dept. of Ceramic Eng. Urbana, IL 61801). pp 571-589 of Advances in materials characterization. Rossington, D.R.; Condrate, R.A.; Snyder, R.L. New York, NY; Plenum Publishing Corp. (1983). (CONF-820891—). Contract AC02-76ER01198.

From 18. ceramic science conference on advances in materials characterization; Alfred, NY, USA (16 Aug 1982).

This chapter determines water concentration and spatial distribution in glass by an autoradiographic method that makes use of tritiated water as the tagged species. Describes the method and presents some typical results. Lists advantages and disadvantages associated with the method and examines other methods that might be used for the study of water in glass. Discusses dry glass preparation, the addition of tritiated water to glass, glass preparation, film selection, and film analysis. Shows tritium autoradiography to be a valuable technique for measuring the content and spatial distribution of water in inorganic glasses. Finds that the technique yields unique information, particularly in regard to spatial distribution, when compared with techniques of IR spectroscopy, SIMS, SIPS, NRRA, ESR and NMR. Points out that large areas (e.g., several square inches) of sample can be mapped in a single exposure. Notes

that the spatial resolution of water in the glass network can be 10^{-7} m, so very accurate diffusion profiles are obtainable.

28851 The characterization of individual redox ions in glasses. Schreiber, H.D. (Dept. of Chemistry Virginia Military Inst. Lexington, VA 24450). pp 647-658 of Advances in materials characterization. Rossington, D.R.; Condrate, R.A.; Snyder, R.L. New York, NY; Plenum Publishing Corp. (1983). (CONF-820891—).

From 18. ceramic science conference on advances in materials characterization; Alfred, NY, USA (16 Aug 1982).

This chapter surveys the analytical methods available for the characterization of individual redox ions in glasses. Emphasizes the characterization in terms of concentrations, coordination chemistries, and mutual interactions. Considers glasses which contain only one multivalent element because of the ease of characterization with a minium of interferences. Examines the applicability of the procedures to glasses containing 2 or more multivalent elements. Discusses "wet" chemistry; optical spectra; electron paramagnetic resonance (EPR) spectroscopy; Moessbauer spectroscopy; Raman spectroscopy; fluorescence spectroscopy; x-ray photoelectron spectroscopy (XPS); extended x-ray adsorption fine structure (EXAFS); electron microprobe; thermogravimetric analysis (TGA); electrochemistry; electrical conductance; viscosity; and magnetic susceptibility.

28852 The thermal transport properties of a POCO AXM-5Q1 graphite from 80 to 970 K. Moore, J.P.; Graves, R.S. (Metals & Ceramics Division Oak Ridge National Lab. Oak Ridge, TN 37830). pp 153-162 of Thermal conductivity. Hust, J.G. New York, NY; Plenum Publishing Corp. (1983). (CONF-8106164—). Contract W-7405-ENG-26.

From National Bureau of Standards joint conferences: 8. symposium on thermophysical properties; 17. thermal conductivity conference; 8. thermal expansion conference; Gaithersburg, MD, USA (15 Jun 1981).

This chapter determines the thermal transport properties of an AXM-5Q1 graphite with nominal room temperature electrical resistivity of 12.6 $\mu\Omega$Xm and density of 1.77 Mg/m^3 using three apparatuses. Shows that the thermal conductivity results display the normal broad maximum near 300 K that is attributed to phonon scattering at the crystallite grain boundaries. Finds that the experimental thermal resistivity is linear to within 0.7% at temperatures from 400 to 970 K. Discusses lattice conduction from 80 to 1000 K and electronic conduction in AXM-5Q1. Concludes that although the thermal resistance of AXM-5Q1 is linear with temperature above 450 K, this may be fortuitous.

28853 Biaxial compression testing of refractory concretes. Bremser, A.H.; Buyukozturk, O. (Babcock & Wilcox Lynchburg, VA). pp 433-440 of Advances in materials characterization. Rossington, D.R.; Condrate, R.A.; Snyder, R.L. New York, NY; Plenum Publishing Corp. (1983). (CONF-820891—). Contract W-7405-ENG-26.

From 18. ceramic science conference on advances in materials characterization; Alfred, NY, USA (16 Aug 1982).

This chapter shows how test equipment was designed and constructed to perform biaxial compression testing at temperatures up to 2000F. Examines a dense and an insulating refractory concrete at various load ratios over a series of temperatures. Finds that both types of refractory concretes exhibited a maximum in ultimate strength when the confining stress was approximately 50% of the primary stress.

28854 Ultra-thin carbon films for high energy plasma generation. Brassell, G.W.; Weber, G.W. (Union Carbide Corp., Oak Ridge, TN). *Science of Advanced Materials and Process Engineering Proceedings;* **23**: 1-9(1978). (CONF-780502—).

From 23. national SAMPE symposium; Anaheim, CA, USA (2 May 1978).

The primary objective of the reported study was to develop methods for fabricating a very thin seamless cylindrical pyrolytic carbon film using chemical vapor deposition (CVD) and to investigate methods of film removal, shipping, and attaching to test electrodes. CVD parameters found to affect film thickness, carbon structure, and mechanical properties include deposition temperature and time, gas composition, and flow rates. Fabrication of thin pyrolytic carbon films was successfully demonstrated. Removal and transfer of the pyrolytic carbon films from the mandrel to the electrodes has not yet been effected to the desired degree.

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28855 (LBL—17070) Chemical Process Research and Development Program. FY 1983 annual report. (Lawrence Berkeley Lab., CA (USA)). Apr 1984. Contract AC03-76SF00098. 52p. NTIS, PC A04/MF A01; 1; GPO Dep. Order Number DE84011424.

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Progress reports are made on the following research topics: high-productivity vacuum fermentation processes for ethanol production; bioconversion of cellulose into cellulase; synthesis of encapsulated arsenic anion; vanadyl and nickel porphyrins and nonporphyrins in heavy crude petroleum and asphaltenes; reduction of polynuclear heteroaromatic compounds; processing of condensate waters fron coal gasification; efficiency of moving-bed coal gasifiers; electrochemical energy storage; battery electrode studies; and advanced thermal energy storage. (DLC)

4001 Analytical And Separations Chemistry

REFER ALSO TO CITATION(S) 27782, 27785, 27787, 27791, 27792, 27874, 27889, 27893, 27896, 27911, 27935, 27975, 28776, 28902, 28967, 29163, 29231, 29317, 29346, 29354, 29428, 29556

28856 (BMFT-FB-T—84-015) Desulphurization of hot reducing gas by means of metal oxides in a fixed bed reactor. Kluge, M.; Proy, G. (Bundesministerium fuer Forschung und Technologie, Bonn (Germany, F.R.)). Mar 1984. 181p. (In German). NTIS (US Sales Only), PC A09/MF A01. Order Number DE84751591.

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The calculation of thermodynamic equilibria for reducing gases in the temperature range of 950 to 1550 K shows that sulfur exists only as hydrogen sulfide and carbon oxysulfide. Theoretical investigations of the reactions of these sulfur compounds with metallic oxides leads to the result that reducing gases with a water content of 5% can be cleaned to sulfur contents less than 50 ppm. Zinc oxide and manganese oxide can be used till about 1050 K, calcium oxides till about 1120 K and barium oxide in the entire temperature range. Experiments were carried out in the fixed bed reactor with barium, zinc and calcium oxide as well as dolomite with particle sizes of 0,8 to 8 mm within the temperature range of 960 to 1300 K. Total sulfur concentrations between 10 and 35 ppm in the gas could be achieved. A mathematical model was developed with which the velocity of sulfur acceptance can be calculated by desulfurization with limestone at 1150 K. The calculation of a reactor scale-up is therefore possible for certain cases. Theoretical investigations of the regeneration of calcium sulfide with steam-oxygen- and oxygen-nitrogen mixtures show that the sulfur concentration in the waste gas increases with the oxygen content of the regeneration gas. In practice, however, a large quantity of calcium sulfate is formed so that a successfull regeneration cannot be carried out. Only very low sulfur concentrations in the waste gas are possible at normal pressure when other regenerating mediums are used. A higher quantity of sulfur concentrations can be achieved with steam, if the steam is condensed out of the regenerating waste gas.

28857 (BNL—34613) Some uncertainties associated with self-calibration of microPIXE analysis. Paschoa, A.S.; Wrenn, M.E.; Bruenger, F.W.; Cholewa, M.; Jones, K.W. (Utah Univ., Salt Lake City (USA). Radiobiology Div.; Brookhaven National Lab., Upton, NY (USA)). 1984. Contract AC02-76CH00016. 8p. (CONF-840408—8). NTIS, PC A02; 3; GPO Dep. Order Number DE84010933.

From 5. international conference on nuclear methods in environmental and energy research; Mayaguez, Puerto Rico (2 Apr 1984).

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The technique of self-calibration, based on internal labelling of target samples with known amounts of a given element, is often used in conventional PIXE analysis of environmental and biological samples, usually when a large number of samples is to be analyzed. However, extreme care should be exercised when attempting to use self-calibration procedures for microPIXE analysis, because the microdistribution of the labelling element in a drop of solution, for example, is usually nonuniform and particle microbeams with a homogeneous profile are difficult to obtain. This paper presents the results of a series of scanning irradiations by a 20 μm proton beam across dried solution drops containing known initial concentrations of thorium which had been deposited onto two different backings. Nonuniform distribution of thorium within the dried drops was observed.

28858 **(CEA-CONF—6954) Recovery of americium contained in residues or analytical effluents by an extraction chromatography process using dihexyl-N, N diethylcarbamylmethylene phosphonate (DHDECMP).** Kwinta, J.; Brossard, P.; Turpain, J.P. (CEA Centre d'Etudes de Bruyeres-le-Chatel, 92 - Montrouge (France)). Sep 1983. 3p. (In French). (CONF-8309124—6). NTIS (US Sales Only), PC A02/MF A01. Order Number DE84750648.

From 1. international conference on the chemistry and technology of the lanthanides and actinides; Venice, Italy (5 Sep 1983).

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Extraction of americium in hydrochloric acid is studied and compared with extraction in nitric acid. Influence of HCl concentration is determined. Americium is recovered from a Purex solution concentrated by evaporation containing HCl and a high concentration of numerous cations. Extraction chromatography of americium on DHDECMP fixed on a chromatograph is quantitative taking into account the accuracy of measurement.

28859 **(CONF-840449—10) Assessment of resonance ionization mass spectrometry for analytical chemistry and spectroscopy.** Young, J.P.; Donohue, D.L.; Smith, D.H. (Oak Ridge National Lab., TN (USA)). 20 Apr 1984. Contract AC05-84OR21400. 9p. NTIS, PC A02/MF A01; GPO Dep. Order Number DE84011650.

From 2. symposium on resonance ionization spectroscopy and its applications; Knoxville, TN, USA (16 Apr 1984).

Resonance ionization mass spectrometry (RIMS) is a natural outgrowth of RIS. The result of an RIS process is an ion pair. The electron can be used to detect the process, and single atom detection has been demonstrated by this method. The cation resulting from the RIS process actually carries more easily accessible and useful information (i.e. the mass of the ion). RIMS is useful in mass analysis. The development of RIMS has proceeded along several different directions, using CW or pulsed lasers, narrow or wide band laser energies, different kinds of sample generation, and different kinds of mass separations. RIMS in various forms can be used to obtain either element or isotope selectivity. Even though the RIMS technique has developed along several lines, several things are common to all approaches. Ultimately RIMS requires gaseous, free, atoms. RIMS makes use of the photoionization of these atoms by absorption of photons through allowed transitions involving real energy levels. The ion once formed is detected by standard mass spectrometric techniques.

28860 **(DOE/ER/13127—03) Capillary separations with calorimetric absorbance detection. Technical progress report, September 1, 1983-August 31, 1984.** Sepaniak, M.J. (Tennessee Univ., Knoxville (USA). Dept. of Chemistry). 1984. Contract AS05-83ER13127. 13p. NTIS, PC A02/MF A01; GPO Dep. Order Number DE84012466.

Three distinct areas of research were pursued during the first year of this contract. First, prior to the arrival of the requested excimer-pumped dye laser, preliminary single beam thermal lens experiments were performed using a departmental argon ion laser. These studies were conducted in order to test the feasibility of performing thermal lens detection in very small flow cells. Second, we have investigated different procedures for treating the inside surfaces of glass and quartz capillary columns in order to provide reasonable capacity and high efficiency in open tabular liquid chromatography separations. Finally, using the requested excimer-pumped dye laser, we have evaluated different optical arrangements for performing pulsed double beam thermal lens detection in small flow cells.

28861 **(GKSS—83/E/57) Inductively coupled argon plasma torch for trace element analysis of heavy metals in suspended particles and sediments.** Schoenburg, M. (GKSS-Forschungszentrum Geesthacht G.m.b.H., Geesthacht-Tesperhude (Germany, F.R.); Hamburg Univ. (Germany, F.R.). Fachbereich Physik). 1983. 117p. (In German). NTIS (US Sales Only), PC A06/MF A01. Order Number DE84751473.

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The inductively coupled argon plasma torch proves to be an excellent excitation source for optical emission spectroscopy and quantitative trace analysis of chemically complicated samples. This paper gives details of the device used. Trace analyses of the heavy metal contents of suspended particles and sediment samples are described; these measurements are part of a more comprehensive experiment that aimes at the elucidation of the heavy metal transport phenomena in tidal rivers.

28862 **(INIS-BR—102) Extraction of Eu(III) and Th(IV) with TBP in n-dodecane in the presence of nitric acid and the thermodynamic activity of the TBP in the system.** Santos, F.S.M. dos. (Pernambuco Univ., Recife (Brazil). Dept. de Energia Nuclear). Feb 1983. 109p. (In Portuguese). NTIS (US Sales Only), PC A06/MF A01. Order Number DE84780184.

A qualitative description of the behavior of distribution coefficients of nitric acid, Th(IV) and Eu(III) separately in the system HNO_3-H_2O-TBP-n-dodecane and the effect of the temperature in the distribution coefficient of Th(IV) are presented. The distribution coefficient of Eu(III) between aqueous solutions nitric acid and solutions of TBP in n-dodecane are measured. Since the composition of the extracted Eu(III) complex is known, the theoretical course of the dependency of the distribution coefficient on the TBP concentration can be predicted. Deviations of experimental dependencies from theoretical ones give them information about the thermodynamic activity of TBP in the organic phase. A mathematical description for the distribution coefficients of Eu(III) and HNO_3 in the mentioned system was sugested. This description will make possible an explanation of the behavior of the activity coefficients of TBP in the organic phase. (A.R.H.).

28863 **(INIS-mf—8920) Determination of ^{226}Ra volume activity in waters.** Dvorak, V.; Vasek, T.; Havlas, J.; Novakova, O.; Svobodova, B. (Tesla, Premysleni (Czechoslovakia). Vyzkumny Ustav Pristroju Jaderne Techniky). 20 Mar 1983. 32p. (In Czech). NTIS (US Sales Only), PC A03/MF A01. Order Number DE84780183.

The design is described of a scintillation detector (Lucas type scintillation chamber) for the determination of ^{226}Ra in waters using the emanometric method. Main attention was focused on the selection of suitable material for the chamber (glass, aluminium, brass, copper, corrosion resistant and machine steel), the determination of the sruface density of the ZnS(Ag) phosphor layer, the dimension optimization of the chamber, the technology of the manufacture of the chamber and the construction of a light-proof sample changer. The main characteristics of the chambers are given as are the partial results of measurements on whose basis the most suitable design appears to be the scintillation chamber manufactured of brass, with a volume of 100 cm^3 provided with a valve (gas closure) on whose inner wall is formed a layer of ZnS(Ag) phosphor with a surface density of 15 to 20 $mg.cm^2$. A background count rate $<0.5\ min^{-1}$ and a total detection efficiency $>80\%$ were achieved. (B.S.).

28864 **(INIS-mf—8927) 60 years of the Institute for Research, Production and Application of Radioisotopes 1919-1979.** Chorvat, K. (ed.). (Ustav pro Vyzkum, Vyrobu a Vyuziti Radioisotopu, Prague (Czechoslovakia)). 1981. 98p. (In Russian). NTIS (US Sales Only), PC A05/MF A01. Order Number DE84780240.

Separate abstracts have been prepared for each report for inclusion in the Energy Data Base.

28865 (INP—1080/PL, pp 142-144) **Contact shifts ^{23}Na NMR of sodium cation solvated by N-oxide radical.** Kolodziejski, W. (Warsaw Univ. (Poland)); Stockis, A.; Laszlo, P. (Liege Univ. (Belgium). Inst. de Chimie). 1980. (In Polish). NTIS (US Sales Only), PC A13/MF A01. Order Number DE84780233. (CONF-791295—). TI84780233

From 12. national seminar on nuclear magnetic resonance and its applications; Cracow, Poland (3 Dec 1979).

The content shifts ^{23}Na NMR in the system $NaClO_4$-tetrahydrofuran - stable radical N-oxide 2,2,6,6-tetramethylpiperidine were studied. ^{23}Na NMR spectra were recorded at the frequency 21,160 MHz on the spectrometer with Fourier transformation.

28866 (INP—1080/PL, pp 26-39) **Nuclear magnetic relaxation in solids involved by complicated reorientation of methyl group.** Jurga, S.; Jurga, K.; Pajak, Z. (Uniwersytet Adama Mickiewicza, Poznan (Poland). Inst. Fizyki). 1980. (In Polish). NTIS (US Sales Only), PC A13/MF A01. Order Number DE84780233. (CONF-791295—). TI84780233

From 12. national seminar on nuclear magnetic resonance and its applications; Cracow, Poland (3 Dec 1979).

A mathematical model in which interproton vector in methyl group may undergo 3 self-dependent anisotropic reorientations round triple symmetry axes and isotropic reorientation round ion or molecule centre of gravity is presented. Spin-lattice relaxation times in temperature function for triethylphospine oxide are interpreted on the basis of presented model.

28867 (INP—1080/PL, pp 169-173) **Quantum resonance transitions induced by oscillating magnetic field.** Nosel, W. (Uniwersytet Jagiellonski, Krakow (Poland). Inst. Fizyki). 1980. (In Polish). NTIS (US Sales Only), PC A13/MF A01. Order Number DE84780233. (CONF-791295—). TI84780233

From 12. national seminar on nuclear magnetic resonance and its applications; Cracow, Poland (3 Dec 1979).

A new attempt of the calculation of probability of quantum resonance transitions induced by oscillating magnetic field is undertaken. The method of normal arrangement of creaction and annihilation operators is applied.

28868 (INP—1080/PL, pp 150-153) **Application of power spectra to analysis of line shape in NMR spectroscopy.** Ejchart, A.; Wroblewski, K. (Polska Akademia Nauk, Lodz. Centrum Badan Molekularnych i Makromolekularnych). 1980. (In Polish). NTIS (US Sales Only), PC A13/MF A01. Order Number DE84780233. (CONF-791295—). TI84780233

From 12. national seminar on nuclear magnetic resonance and its applications; Cracow, Poland (3 Dec 1979).

The usefulness of power spectra to analysis of line shape in NMR spectroscopy was studied. The comparison of the accuracy of fitting the parameters determining the outlines of power and absorption spectra was done. The application of power spectra to analysis of line shape is profitable.

28869 (INP—1080/PL, pp 221-225) **Influence of solvent on proton transport in complexes of pyridine alkalines with trifluoroacetic acid.** Dega-Szafran, Z.; Dulewicz, E. (Uniwersytet Adama Mickiewicza, Poznan (Poland). Inst. Chemii). 1980. (In Polish). NTIS (US Sales Only), PC A13/MF A01. Order Number DE84780233. (CONF-791295—). TI84780233

From 12. national seminar on nuclear magnetic resonance and its applications; Cracow, Poland (3 Dec 1979).

The influence of solvent on proton transport in complexes of pyridine alkalines with trifluoroacetic acid was studied by nuclear magnetic resonance. The values of proton chemical shift are given. The influence of solution strength on chemical shift is also presented.

28870 (INP—1080/PL, pp 226-231) **Electromagnetic field "coated" atom.** Szpilecki, J. 1980. (In Polish). NTIS (US Sales Only), PC A13/MF A01. Order Number DE84780233. (CONF-791295—). TI84780233

From 12. national seminar on nuclear magnetic resonance and its applications; Cracow, Poland (3 Dec 1979).

In the radiospectroscopy case the solution of electromagnetic field "coated" atom equation is given.

28871 (INP—1080/PL, pp 232-237) **Relaxation times in stochastic mixed systems.** Szpilecki, J. 1980. (In Polish). NTIS (US Sales Only), PC A13/MF A01. Order Number DE84780233. (CONF-791295—). TI84780233

From 12. national seminar on nuclear magnetic resonance and its applications; Cracow, Poland (3 Dec 1979).

For the electromagnetic field "coated" atom with stochastically varying parameters the equation is obtained with constant parameters by introduction of relaxation times.

28872 (INP—1080/PL, pp 238-241) **Matrix elements, correlation functions and spectral density in stochastic mixed system.** Szpilecki, J. 1980. (In Polish). NTIS (US Sales Only), PC A13/MF A01. Order Number DE84780233. (CONF-791295—). TI84780233

From 12. national seminar on nuclear magnetic resonance and its applications; Cracow, Poland (3 Dec 1979).

The calculation of matrix elements, correlation functions and spectral densities for the stochastic mixed system is given.

28873 **(Juel—1822) Monostandard method in thermal neutron activation analysis.** Alian, A.; Djingova, R.G.; Kroener, B.; Sansoni, B. (Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.). Zentralabteilung fuer Chemische Analyse). Jan 1983. 27p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE84751328.

A simple method is described for instrumental multielement thermal neutron activation analysis using a monostandard. For geological and air dust samples, iron is used as a comparator, while sodium has advantages for biological materials. To test the capabilities of this method, the values of the effective cross sections of the 23 elements determined were evaluated in a reactor site with an almost pure thermal neutron flux of about 9×10^{12} n x cm^{-2} x sec^{-1} and an epithermal neutron contribution of less than 0,03%. The obtained values were found to agree mostly well with the literature best values of thermal neutron cross sections. The results of an analysis by activation in the same site agree well with the relative method using multielement standard and for several standard reference materials with certified element contents. A comparison of the element contents obtained by the monostandard and relative methods together with corresponding precisions and accuracies is given. A brief survey of the monostandard method is presented.

28874 **(LBL—16405) Surface studies using optical second-harmonic generation.** Tom, H.W.K.; Heinz, T.F.; Shen, Y.R. (California Univ., Berkeley (USA). Dept. of Physics; Lawrence Berkeley Lab., CA (USA)). Feb 1984. Contract AC03-76SF00098. 9p. (CONF-831265—3). NTIS, PC A02; 3; GPO Dep. Order Number DE84010717.

From 6. international conference on lasers and applications; San Francisco, CA, USA (12 Dec 1983).

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Optical second-harmonic generation (SHG) from a system of two centrosymmetric media arises largely from the interface between the media. This interfacial-specificity allows SHG to be a useful probe of a variety of surface properties including: surface adsorbate coverage, adsorbate orientation and arrangement on the substrate, the site of adsorption and surface structural symmetry. The versatility and sensitivity of SHG as a surface probe is illustrated with examples drawn from our most recent work.

28875 **(LBL—17390) New approaches to photothermal spectroscopy.** Amer, N.M. (Lawrence Berkeley Lab., CA (USA)). Feb 1984. Contract AC03-76SF00098. 5p. (CONF-840725—2). NTIS, PC A02/MF A01; GPO Dep. Order Number DE84009237.

From 3. international conference on infrared physics; Zurich, Switzerland (23 Jul 1984).

In recent years, the small rise in temperature associated with the absorption of light has provided the basis for a new class of

spectrotroscopy which can be loosely called photothermal spectroscopy. Until recently, the more familiar member of this family has been photoacoustic spectroscopy where the optical heating is converted into sound and is detected with a suitable transducer. Although this approach has proven to be useful, the ultimate sensitivity of photoacoustics can be limited by the scattering of light on the transducer. Furthermore, in the case of experiments requiring a wide range of temperatures and pressures, or involving hostile environment, both microphone and piezoelectric photoacoustic detections cannot be employed. To overcome these limitations the optical heating has to be exploited in different ways. The principles of photothermal deflection spectroscopy and photothermal displacement spectroscopy are described.

28876 **(NP—4770279) Investigations on application of neutron activation analysis within the scope of an analytical 'Verbundverfahren' (integrated method) for the determination of trace elements in sea water.** Ammann, K. (Hamburg Univ. (Germany, F.R.). Fachbereich Chemie). 17 Dec 1981. 380p. (In German). NTIS (US Sales Only), PC A17/MF A01. Order Number DE84770279.

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The application of neutron activation analysis (NAA) to the determination of trace elements in sea water proves to be problematic because of the high radioactivity produced during the activation process by the chief components of sea salt. The instrumental NAA may be used after the decay of the violently radiating nuclides; but it is applicable to the determination of a limited number of elements only. To increase the number of elements, which can be determined by neutron activation of sea salt an early division of the irradiated specimen into disturbing nuclides of chief components and nuclides belonging to trace elements is necessary. For this aim the selective separation of the main components concerned offers the best conditions, since by that the whole of trace elements remains in solution and possibly can be analysed simultaneously. Different separation methods consisting of one or two steps and allowing the removal of ^{24}Na, ^{42}K, ^{38}Cl, and sup(80/82)Br from solutions of irradiated sea salt have been devised, developed, and tested. As against the instrumental NAA the described procedure allows the additional determination of elements with short-lived activation products. An experimental determination of the limits of detection achieved by this method eludicates its efficiency for the determination of trace elements in sea salt and similarly composed specimen.

28877 **(PB—84-152107) Review of anhydrous zirconium-hafnium separation techniques. Information circular/1984.** Skaggs, R.L.; Rogers, D.T.; Hunter, D.B. (Bureau of Mines, Albany, OR (USA). Albany Research Center). Dec 1983. 32p. NTIS, PC A03/MF A01.

Library of Congress catalog card No. 83-20940.

Sixteen nonaqueous techniques conceived to replace the current aqueous scheme for separating hafnium and zirconium tetrachlorides were reviewed and evaluated by the Bureau of Mines. The methods are divided into two classes: separation by fractional volatilization of the tetrachlorides, which takes advantage of the higher volatility of hafnium tetrachloride; and separation by chemical techniques, based on differences in chemical behavior of the two tetrachlorides. The criteria used to evaluate separation methods were temperature, pressure, separation factor per equilibrium stage, complexity, compatibility with existing technology, and potential for continuous operation. Three processes were selected as being most promising: (1) high-pressure distillation, (2) extractive distillation from a molten salt, and (3) preferential reduction of gaseous ZrCl4. Any of the proposed nonaqueous Hf-Zr separation schemes must be supplemented with additional purification to remove trace impurities.

28878 **(PB—84-152461) Optical studies of polycyclic aromatic hydrocarbons in pyrolysis and diffusion flame environments. Final report.** Miller, J.H.; Mallard, W.G.; Smyth, K.C. (National Bureau of Standards, Washington, DC (USA)). 1982. 15p. Pub. in Proceedings of Polynuclear Aromatic Hydrocarbons: International Symposium on Formation, Metabolism, Measurement (7th), held at Columbus, OH. on October 26-28, 1982, p905-919.

In the present work results are presented for two types of optical measurements of PAH in fuel rich systems: ultraviolet absorption spectroscopy (in a flowing pyrolysis tube and in a slot burner supporting a diffusion flame) and visible laser-induced fluorescence. Preliminary results show that the absorption spectrum obtained in a flowing, 50 torr mixture of 1,3-butadiene and nitrogen at 600-700 K is similar in spectral shape to an absorption spectrum taken under identical optical conditions in a diffusion flame. From this spectral shape it is determined that PAH from 1 to 4 rings in size are present in the sampled area (2 mm diameter), which is on the fuel side of the flame front. A spatial profile of the broad, unstructured fluorescence observed when probing with a visible laser beam peaks in approximately the same position in the flame.

28879 **(PB—84-156496) EPA/NIH (Environmental Protection Agency/National Institutes of Health) mass spectral data base, supplement 2, 1983; includes 1983 cumulative indexes.** Heller, S.R.; Milne, G.W.A.; Gevantman, L.H. (National Standard Reference Data System (USA)). [nd]. 2110p. (NSRDS-NBS—63-SUPPL-2). NTIS, PC A99/MF E15.

Supersedes PB81-189367; Library of Congress catalog card No. 78-606175.

This second Supplement to the EPA/NIH Mass Spectral Data Base (NSRDS-NBS 63) presents an additional collection of 6557 verified mass spectra of individual substances compiled from the EPA/NIH mass spectral file. The spectra are given in bar graph format over the full mass range. Each spectrum is accompanied by a Chemical Abstracts Index substance name, molecular formula, molecular weight, structural formula, and Chemical Abstracts Service Registry Number. A cumulative index has also been issued which provides access to the entire file of mass spectra.

28880 **(PB—84-163542) Certification of a uranium metal reference material for chemical analyses.** Duigou, Y.L. (Commission of the European Communities, Luxembourg). 1983. 34p. (EUR—8349-EN). NTIS, PC AE03/MF E03.

Interlaboratory comparative analyses of impurities in a sample of high-purity uranium metal are reported and previous analytical results are shown to have been verified. Impurities are major (above 5 micrometers g/g, e.g. Fe, Si, N and O), minor (a few tenths to 5 micrometers g/g, e.g. Al, Cr), or trace. Various methods were used and results are presented; results of spark source mass spectrometry by one laboratory are tabulated.

28881 **(PNL-SA—11699-Rev.) Utilization of a ^{252}Cf-^{235}U fueled subcritical multiplier for neutron activation analysis. Rev.** Wogman, N.A.; Lepel, E.A. (Pacific Northwest Lab., Richland, WA (USA)). Feb 1984. Contract AC06-76RL01830. 9p. (CONF-840408—1-Rev.). NTIS, PC A02; 3; GPO Dep. Order Number DE84011862.

From 5. international conference on nuclear methods in environmental and energy research; Mayaguez, Puerto Rico (2 Apr 1984).

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A ^{252}Cf neutron activation analysis facility developed in 1975 has been used for the routine multielement analysis of a wide variety of solid and liquid samples. The present neutron flux is on the order of 10^9 thermal neutrons per cm^2 per second. Following activation, the radioisotopes are analyzed through their photon emissions with lithium drifted germanium detectors, anticoincidence shielded germanium detectors and NaI(T1) coincidence spectrometers. Although over 65 elements have been measured in environmental materials with this system, typical analyses include the elements Na, Al, Cl, K, Ca, Ti, V, Mn, Br, Sr, Rb, Ba, and Dy. Detection limits range from the sub parts per million upward. Over 8000 samples have been analyzed at an amortized neutron cost per sample of $31.

28882 **(RFP—3275) Quality engineering and control. Annual progress report, January-December 1981.** Carpenter, R.L. (Rockwell International Corp., Golden, CO (USA). Rocky Flats Plant). 20 Apr 1984. Contract AC04-76DP03533. 21p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE84011603.

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Brief summaries are given of research carried out in the following areas: absorption spectroscopy of titanium, niobium, and molybdenum in uranium alloys; atomic absorption spectroscopy of selenium in stainless steel, computer program improvements for spectrophotometer control, and detection of beryllium in stack gases; electrolysis for inactivation of bacteria in cooling-tower water; improved solvent analysis by gas chromatography; sequential radionuclide separation for various sample matrices; progress on an electron microprobe analyzer; and miscellaneous projects. (GHT)

28883 **Long path length temperature-controlled absorption cell for spectroscopic studies of radioactive compounds.** Briesmeister, R.A.; Read, G.W.; Kim, K.C.; Fitzpatrick, J.R. (Chemistry Division and Materials Science Technology Division, University of California, Los Alamos National Laboratory, P.O. Box 1663, Los Alamos, New Mexico 87545). *Applied Spectroscopy;* **38**: No. 1, 35-38(Jan 1984).

A unique long-path absorption cell has been developed for spectroscopic studies of alpha radioactive compounds. The cell is temperature programmable from room temperature down to 100 K and has an optical path length up to 0.5 km. Special design features and performance characteristics are described.

28884 **On-line analysis of ultra low-level CO_2 concentrations in gas streams.** Haag, G.L.; Green, D.F. (Oak Ridge National Lab., TN). *Analytical Letters;* **17**: No. A2, 123-134(1984). Contract W-7405-ENG-26.

The on-line analysis of gas streams containing ultra low-level concentrations of CO_2 over extended time periods presents a unique analytical problem. In the absence of a CO_2 preconcentration step, many commercially available instruments used for routine gas analysis lack either the sensitivity or stability for ultra low-level CO_2 monitoring. Two relatively inexpensive (<$10,000) techniques were found suitable for such monitoring: 1) CO_2 methanation with subsequent flame ionization detection, and 2) extended-pathlength infrared spectroscopy.

28885 **Relative importance of diffusion and chemical reactions in liquid-liquid extraction kinetics.** Danesi, P.R. (Argonne National Lab., IL). *Solvent Extraction and Ion Exchange;* **2**: No. 1, 29-44(1984). Contract W-31-109-ENG-38.

The relative importance of interfacial diffusion and chemical reactions in determining the overall kinetics of liquid-liquid extraction of metal cations is discussed. The different criteria which can be used to identify if the rate of extraction is controlled by diffusion, interfacial chemical reactions or homogeneous chemical reactions are briefly reviewed. A chemical system where interfacial and aqueous phase chemical reactions are simultaneously controlling the rate of metal extraction is described. 6 figures.

28886 **Behavior of trace refractory minerals in the lithium metaborate fusion-acid dissolution procedure.** Feldman, C. (Oak Ridge National Lab., TN). *Analytical Chemistry;* **55**: No. 14, 2451-2453(Dec 1983). Contract W-7405-ENG-26.

The feasibility of this procedure was investigated using minerals and ore specimens. The substances were ground then fused using $LiBO_2$, quenched with 3% HNO_3 or mixtures of the acid with 2.5% tartaric acid or 30% H_2O_2. The quenched melt was usually completely dissolved within 20 min by placing the beakers in an ultrasonic bath. If any residue was detected, appropriate changes were made in the procedure. Once the procedure has been optimized, any remaining black particles were filtered. If these particles disappeared upon subsequent ignition, they were presumed to have been graphite. Most of the refractory minerals investigated should be expected to be converted to soluble form by this process. 1 table.

28887 **(DP-tr—67) Isolation of nitrosylruthenium nitrato complexes by ion exchange and extraction chromatography.** Huang, H.; Liu, L. Translated from *Heh Hua Hsueh Yu Fang She Hua Hsueh ;* **5**: No. 4, 273-280(Nov 1983). Contract AC09-76SR00001. 16p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE84012860. DE84012860

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TBP Levextrel and cation exchange resins were used to separate RuNO nitrato complexes of different nitric acid concentrations. 7402 quaternary ammonium salt Levextrel was used instead of an anionic exchange resin to separate anionic and neutral complex ions. The results indicated that D_3 and D_4, which can easily be extracted by TBP, were anionic and neutral complex ions.

28888 **Multielement analysis of unweighed oil samples by x-ray fluorescence spectrometry with two excitation sources.** Sanders, R.W. (Pacific Northwest Lab., Richland, WA); Olsen, K.B.; Weimer, W.C.; Nielson, K.N. *Analytical Chemistry;* **55**: No. 12, 1911-1914(Oct 1983). Contract AC06-76RL01830.

A method has been developed to compute matrix corrections for unweighed oil samples from the combined results of two separate energy-dispersive X-ray fluorescence spectra from different (Ti Kα, Zr Kchemical bond) excitation sources. The method utilizes the incoherent and coherent scatter intensities from the Zr-excited spectrum as a basis for multielement back-scatter/fundamental parameter matrix corrections for both spectra. The Ti-excited spectrum is collected in a helium atmosphere and provides more sensitive determination of elements in the Al-Ca range. The method utilizes thin film multielement calibrations of the spectrometer and permits the direct analysis of samples of varying unknown mass and composition with high accuracy and precision. 2 figures, 3 tables.

28889 **Continuous wave lasers for resonance ionization mass spectrometry.** Miller, C.M.; Nogar, N.S. (Los Alamos National Lab., NM). *Analytical Chemistry;* **55**: No. 9, 1606-1608(Aug 1983). Contract W-7405-ENG-36.

Reported are results of using continuous wave lasers (CW) in resonance ionization mass spectroscopy for isotopic analysis. Typical ionization yields for CW irradiations of the samples were (2 - 6) x 10_8 ion/s, comparing favorably with yields reported from flashlamp pumped dye lasers. The enhancement exceeds the expectation of rate-equation calculations. The measured selectivity of the resonance ionization process is enhanced, as well as demonstrated, in a mass scan for an equal-atom Lu/Yt sample, and in the fidelity of the $^{175}Lu/^{176}Lu$ ratio in mixed Lu/Yt samples, in spite of an isobaric ^{176}Yb interference. In general, a ratio within 5% of accepted value of 37.6 was found with a 2 min measurement at each mass.

28890 **Separation of certain carboxylic acids utilizing cation exchange membranes.** Chum, H.L.; Sopher, D.W. (to Dept. of Energy). US Patent Application 6-492,925. 9 May 1983. 21p. Contract AC02-77CH00178.

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A method of substantially separating monofunctional lower carboxylic acids from a liquid mixture containing the acids wherein the pH of the mixture is adjusted to a value in the range of from about 1 to about 5 to form protonated acids. The mixture is heated to an elevated temperature not greater than about 100°C and brought in contact with one side of a perfluorinated cation exchange membrane having sulfonate or carboxylate groups or mixtures thereof with the mixture containing the protonated acids. A pressure gradient can be established across the membrane with the mixture being under higher pressure, so that protonated monofunctional lower carboxylic acids pass through the membrane at a substantially faster rate than the remainder of the mixture thereby substantially separating the acids from the mixture.

28891 **Simulation as an aid to experimental design.** Frazer, J.W.; Balaban, D.J.; Wang, J.L. (Lawrence Livermore National Lab., CA). *Analytical Chemistry;* **55**: No. 6, 904-910(May 1983). Contract W-7405-ENG-48.

A simulator of chemical reactions can aid the scientist in the design of experimentation. They are of great value when studying enzymatic kinetic reactions. One such simulator is a numerical ordinary differential equation solver which uses interactive graphics to provide the user with the capability to simulate an extremely wide range of enzyme reaction conditions for many types of single substrate reactions. The concentration vs. time profiles of any subset or all nine states of a complex reaction can be displayed with and without simulated instrumental noise. Thus the user can estimate

the practicality of any proposed experimentation given known instrumental noise. The experimenter can readily determine which state provides the most information related to the proposed kinetic parameters and mechanism. A general discussion of the program including the nondimensionalization of the set of differential equations is included. Finally, several simulation examples are shown and the results discussed.

28892 High-resolution detection of collision-induced dissociation fragments by Fourier transform mass spectrometry. Cody, R.B.; Freiser, B.S. (Purdue Univ., West Lafayette, IN). *Analytical Chemistry;* **54**: No. 8, 1431-1433(Jul 1982). Contract AC02-80ER10689.

Results of the application of Nicolet prototype Fourier transform mass spectrometers (FTMS) technique to the study of collision-induced dissociation (CID) of proton-bound alcohol dimers and metal-ion bound alcohol dimers are reported. Sequential CIDs have been observed by operating the instrument in an MS/MS/MS manner to examine the CID of ions that are themselves the result of CID fragmentation. The recorded spectra were all obtained by operating the instrument in the heterodyne mode. The molecular ions of acetone and isopropyl chloride both undergo CID to give isobaric ions of a nominal m/Z 43. However, the fact that the accuracy of the mass measurements of the recorded spectra is somewhat less than had been previously reported may be partly due to a perturbation of the trapping cell electric field due to a modification of the apparatus. It was noted that both resolution and the maximum translational energy that can be imparted to an ion before ejection are inversely proportional to ionic mass.

28893 Liquid chromatographic separation of aromatic hydrocarbons with chemically bonded (2,4-dinitroanilinopropyl) silica. Grizzle, P.L.; Thomson, J.S. (Bartlesville Energy Technology Center, OK). *Analytical Chemistry;* **54**: No. 7, 1071-1076(Jun 1982).

A detailed comparison of alumina and chemically bonded silica-R(NH_2)$_2$ and (2,4-dinitroanilinopropyl)silica (DNAP-silica) for the compound-class (ring-numbered) high-performance liquid chromatographic separation of aromatic hydrocarbons was made with 86 model compounds either expected or known to be present in petroleums, coal liquids, or shale oils. Model compounds ranged from one-ring aromatic hydrocarbons to highly condensed polyaromatic hydrocarbons containing six aromatic rings. The importance of substituent and structure effects on separations was determined by varying the degree of alkyl and naphthenic substitution on the basic ring structures. Determination of the best system was based upon the relative retention strengths, grouping tendencies, and the observed structure and substituent effects. The silica-DNAP and alumina were determined to be more sensitive to molecular structure but less sensitive to substituent effects than the silica-R(NH_2)$_2$. The retention characteristics of all three systems are strongly dependent upon steric effects. On the basis of retention strengths and grouping tendencies, the DNAP-silica is considered superior to alumina and silica-R(NH_2)$_2$.

28894 On-line multidimensional liquid chromatographic determination of polynuclear aromatic hydrocarbons in complex samples. Sonnefeld, W.J. (Univ. of Maryland, College Park); May, W.E., Wise, S.A. *Analytical Chemistry;* **54**: No. 4, 723-727(Apr 1982).

A method is described for the on-line coupling of a normal-phase high-performance liquid chromatographic (HPLC) system to a reversed-phased HPLC system. The method employs a diamine column for on-column concentration of a selected fraction from a normal-phase aminosilane column followed by a solvent exchange procedure and gradient elution focusing of the analyte species onto a reversed-phase octadecyisilane column. No loss of analyte of chromatographic resolution is observed by using this method. Several chromatographic packing materials were investigated for use as on-column concentrators of polynuclear aromatic hydrocarbons (PAH) from normal-phase chromatographic systems. The validity of this approach was verified by determining the concentration of several PAH in Standard Reference Material (SRM) 1580 - "Organics in Shale Oil". 4 figures, 3 tables.

28895 Organic analysis with a combined capillary gas chromatograph/mass spectrometer/Fourier transform infrared spectrometer. Crawford, R.W.; Hirschfield, T.; Sanborn, R.H.; Wong, C.M. (Lawrence Livermore National Lab., CA). *Analytical Chemistry;* **54**: No. 4, 817-820(Apr 1982). Contract W-7405-ENG-48.

The authors have demonstrated, for the first time, a linked capillary gas chromatograph/mass spectrometer/Fourier transform infrared spectrometer (GC/MS/FT-IR). Although the linking of a packed column GC/MS/FT-IR has been reported, they feel the use of a high-resolution column (SCOT) significantly increases the analytical usefulness of this technique. The linking of the three provides complementary information and eliminates the possibility of comparing spectra from different components due to shifts in retention time. Examples are given by using a known mix of alkyl benzenes and a completely unknown siloxane.

28896 Indirect determination of cyanide by single-column ion chromatography. DuVal, D.L.; Fritz, J.S.; Gjerde, D.T. (Iowa State Univ., Ames). *Analytical Chemistry;* **54**: No. 4, 830-832(Apr 1982). Contract W-7405-ENG-82.

The procedure was developed by modification of a pneumoamperometric method which uses the reaction of cyanide with iodine, since the final concentration of iodide is proportional to the initial concentration of cyanide. The sample is diluted so that the cyanide concentration is in the range of .5 - 10 ppm, acetate buffer is added to adjust the pH to a value between 4.5 and 6. Excess iodine is added in 95% ethanol, sample is diluted to constant volume and allowed to stand for ca 5 min. Small aliquots of sample are injected slowly into the ion chromatograph through a precolumn containing XAD-4 resin. The excess iodine is adsorbed on this precolumn. The ion chromatograph adsorbs the iodide reaction product on XAD-1 resin. The iodide is removed by elution with sodium phthalate. Retention time is ca 5 min. Contamination of the system may be prevented by the removal of the precolumn for iodine desorption using nitric acid in acetone and water. 2 figures, 3 tables.

28897 Multielement analysis of unweighed biological and geological samples using backscatter and fundamental parameters. Nielson, K.K.; Sanders, R.W. (Rogers and Associates Eng. Corp. Salt Lake City, UT 84107). *Advances in X-Ray Analysis;* **26**: 385-390(1982). (CONF-820861—). Contract AC06-76RL01830.

From 31. annual Denver X-ray conference; Denver, CO, USA (3 Aug 1982).

This chapter describes extended capabilities of the backscatter with fundamental parameter (BFP) method, which was originally applied only to well-defined samples over a more restricted range of compositions. It demonstrates that the BFP calculation method accurately computes both the effective thickness and the bulk composition of individual samples. It shows how the BFP method provides accurate multielement analyses of biological and geological materials without similar standards. It also examines the analyses of loose powders as well as pelletized quantitative analysis of unknown, unweighed samples by calculation of sample bulk constituents and thickness from the backscatter peaks. Besides reducing preparation and calibration costs, the BFP method avoids the potential contamination and dilution often associated with sample preparation because most materials can be directly analyzed as loose powders, solid lumps or pellets.

28898 New instruments for plant area and personnel monitoring. Gammage, R.B.; Hawthorne, A.R.; Schuresko, D.D.; Vo-Dinh, T. (Health and Safety Research Division Oak Ridge National Laboratory Oak Ridge, Tennessee). *Alternative Energy Sources;* **6**: 209-228(Dec 1980). (CONF-801210—). Contract W-7405-ENG-26.

From 3. Miami international conference on alternative energy sources; Miami Beach, FL, USA (15 Dec 1980).

Advances in portable monitoring instruments and simple luminescence techniques for analyzing PNAs are reported. A small, derivative ultra-violet absorption spectrometer is suitable for multipollutant real-time monitoring of several mono- and bicyclic aromatic vapors. A non-compound selective fluorescence spill spotter

and lightpipe luminoscope are active instruments for measuring general surface and skin contamination, respectively. A small, passive, integrating, filter paper exposure device that responds to PNA vapors such a pyrene, is a very promising and recent development. Synchronous luminescence and room temperature phosphorescence are two attractive and simple to use analytical methodologies for the rapid assaying of major PNA compounds. Their potential for analyzing the cyclohexane extract of particulate matter, or incorporation into a device for the continuous monitoring of select PNAs in aerosols in near-real-time, are discussed.

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REFER ALSO TO CITATION(S) 28885, 28892, 28893, 28952, 28963

28899 **(CONF-8310251—2) Metallic cobalt and iron particles in large and medium pore zeolites. Methods of generation and ferromagnetic resonance characterization.** Iton, L.E.; Beal, R.B.; Hamot, P.J. (Argonne National Lab., IL (USA); University of South Florida, Tampa (USA); Northwestern Univ., Evanston, IL (USA)). 1983. Contract W-31-109-ENG-38. 20p. NTIS, PC A02/MF A01; GPO Dep. Order Number DE84011701.

From US-Western Europe regional seminar on metal complex catalysts and metal catalyzed reactions in intracrystalline environments; Brugge, Belgium (24 Oct 1983).

Spectroscopic studies utilizing photoacoustic electronic spectroscopy, electron paramagnetic resonance, and ferromagnetic resonance have been made on the formation of (1) Co metal particles from $CO(NH_3)_6^{3+}$ exchanged into Y zeolite and (2) Fe metal particles from nonframework Fe^{3+} ions in an aluminoferrisilicate analogue of ZSM-5 zeolite. Decomposition of the $Co(NH_3)_6^{3+}$ complex is accompanied by autoreduction to the Co^{2+} state, observed by EPR at 7°K, but no Co metal is formed. The Co^{2+} ions migrate from the supercage locations of the parent complexes into the hexagonal prisms and are subsequently very difficult to reduce, even with H_2 at 823°K. High-temperature FMR data suggest that the small amount of Co metal particles which are formed exist with the fcc crystal structure yielding g = 2.17 at 508°K, consistent with an empirically calculated value for fcc Co. Hexagonal close packed Co particles are expected to exhibit much larger magnetic anisotropy than was observed. The Fe^{3+} ions in the medium pore pentasil aluminoferrisilicate zeolite can be reduced to the metallic state following either (a) precipitation of the inclusion compound, Fe/sup III/ [Fe/sup II/$(CN)_5(NO)$], in the zeolite, or (b) generation of superparamagnetic oxidic ferric ion clusters. High-temperature FMR data establish that smaller Fe particles can be obtained by the latter method.

28900 **(CONF-8404110—3) Predictions of entropies of molecules and liquids.** Blander, M.; Stover, C. (Argonne National Lab., IL (USA)). Apr 1984. Contract W-31-109-ENG-38. 18p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE84010504.

From 4. international conference on high temperature science - HYTHERM; Santa Fe, NM, USA (2 Apr 1984).

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A reanalysis of classical partition functions for vapor molecules leads to a modified equation for the prediction of relative values of nonelectronic entropies in terms of atomic masses and size parameters. Correspondence of predictions with tabulated data on nonhydrogenic molecules of up to seven atoms is very good. Theoretical integrals for diatomic and triatomic molecules have been evaluated for a simple ionic potential; the results are in good agreement with measured entropies of ionic and nonionic molecules indicating that the theory permits one to predict absolute values of entropies for any type of molecule. Differences between bent and linear triatomic molecules appear to be related more to bond character than to molecular geometry. The application of our equations to alkali halide liquids requires a correction term which is related to the observed penetration of ions into the coordination shell of like charged ions. The semi-empirical use of the cube root of the molar volume as an effective size parameter leads to very good correlations of the entropies of all the alkali halides.

28901 **(DOE/ER/04341—6) Chemical poisoning in model heterogeneous reactions. Final report, May 1, 1977-April 30, 1983.** Bernasek, S.L. (Princeton Univ., NJ (USA). Dept. of Chemistry). Apr 1984. Contract AC02-77ER04341. 8p. NTIS, PC A02/MF A01; GPO Dep. Order Number DE84012461.

Over the period work developed mainly in three areas: molybdenum surface chemistry, molybdenum oxide surface chemistry, and the development of transition metal compounds as models for chemical poisoning studies.

28902 **(DOE/ER/10414—T2) Chemistry of gaseous lower-valent actinide halides. Technical progress report.** Hildenbrand, D.L. (SRI International, Menlo Park, CA (USA)). 25 Apr 1984. Contract AT03-79ER10414. 10p. NTIS, PC A02/MF A01; GPO Dep. Order Number DE84011892.

Objective is to provide thermochemical data for key actinide halide and oxyhalide systems. Progress is reported on bond dissociation energies of gaseous $ThCl_4$, $ThCl_3$, $ThCl_2$, and ThCl; bond dissociation energies of ruthenium fluorides; and mass spectroscopy of UF_6.

28903 (INP—1080/PL, pp 116-123) **Study of hydrated zinc perchlorate $[Zn/H_2O/_6]/ClO_4/_2$ by NMR of broad lines.** Borzecka, B.; Hodorowicz, S. (Uniwersytet Jagiellonski, Krakow (Poland). Inst. Chemii); Sagnowski, S. (Institute of Nuclear Physics, Krakow (Poland)). 1980. (In Polish). NTIS (US Sales Only), PC A13/MF A01. Order Number DE84780233. (CONF-791295—). TI84780233

From 12. national seminar on nuclear magnetic resonance and its applications; Cracow, Poland (3 Dec 1979).

The NMR spectra of polycrystalline sample of zinc perchlorate were recorded in the temperature range 77-293 K on the spectrometer of broad lines working at the frequency 17,465 MHz. The values of the second moments of absorption lines were calculated on MERA-400 computer. The dependence of the second moment on the temperature is shown.

28904 (INP—1080/PL, pp 87-96) **Screening of ^{23}Na nuclei in $NaNO_3$ and $NaClO_3$ crystals.** Sagnowski, S. (Institute of Nuclear Physics, Krakow (Poland)). 1980. (In Polish). NTIS (US Sales Only), PC A13/MF A01. Order Number DE84780233. (CONF-791295—). TI84780233

From 12. national seminar on nuclear magnetic resonance and its applications; Cracow, Poland (3 Dec 1979).

The results of the studies of screening of ^{23}Na nucleus in $NaNO_3$ and $NaClO_3$ ionic crystals are presented. The measurements were carried out using NMR spectrometer of continuous wave operating with working frequency 14 MHz.

28905 (INP—1080/PL, pp 97-104) **About study of fibrous hydrates of isopolytrimolybdates by proton NMR method of broad lines.** Surga, W. (Wyzsza Szkola Pedagogiczna, Kielce (Poland)); Sagnowski, S. (Institute of Nuclear Physics, Krakow (Poland)); Hodorowicz, S. (Uniwersytet Jagiellonski, Krakow (Poland). Inst. Chemii). 1980. (In Polish). NTIS (US Sales Only), PC A13/MF A01. Order Number DE84780233. (CONF-791295—). TI84780233

From 12. national seminar on nuclear magnetic resonance and its applications; Cracow, Poland (3 Dec 1979).

The polycrystalline samples of rubidium and cesium isopolytrimolibdates were investigated using the conventional broad lines spectrometer. The obtained spectra are presented.

28906 (INP—1080/PL, pp 105-110) **NMR and ESR study of the chrysotile asbestos.** Murin, J.; Olcak, D.; Hronsky, V.; Rakos, M.; Skokanova, Z.; Krocan, J. (Vysoka Skola Technicka, Kosice (Czechoslovakia)). 1980. NTIS (US Sales Only), PC A13/MF A01. Order Number DE84780233. (CONF-791295—). TI84780233

From 12. national seminar on nuclear magnetic resonance and its applications; Cracow, Poland (3 Dec 1979).

NMR and ESR measurements of the chrysotile asbestos were performed at room temperature by means of spectrometer

RYa-2301. The orientation of the microfibres and the degree of crystallinity of the samples were studied by the NMR method. ESR method was used for identification of the paramagnetic ions and ferromagnetic impurities.

28907 (INP—1080/PL, pp 1-8) **Quasi-stationary measuring method of selective times of spin-lattice relaxation in liquids.** Jurga, K. (Uniwersytet Adama Mickiewicza, Poznan (Poland). Inst. Fizyki). 1980. (In Polish). NTIS (US Sales Only), PC A13/MF A01. Order Number DE84780233. (CONF-791295—). TI84780233

From 12. national seminar on nuclear magnetic resonance and its applications; Cracow, Poland (3 Dec 1979).

Quasi stationary measuring method of times of spin-lattice relaxation in liquids is shortly described. Block diagram of measuring set is given. Presented method is better than stationary and impulse methods.

28908 (INP—1080/PL, pp 13-25) **Molecular dynamics in methylammonium salts studied by NMR.** Jurga, S.; Jurga, K.; Pajak, Z. (Uniwersytet Adama Mickiewicza, Poznan (Poland). Inst. Fizyki). 1980. (In Polish). NTIS (US Sales Only), PC A13/MF A01. Order Number DE84780233. (CONF-791295—). TI84780233

From 12. national seminar on nuclear magnetic resonance and its applications; Cracow, Poland (3 Dec 1979).

The results of studies of relaxation times and the second moment in tetra-, tri-, diamethylammonium perchlorate are presented. The measurements were carried out on impulse spectrometer at frequency 25 MHz.

28909 (INP—1080/PL, pp 168) **Influence of H_0 field on NMR spectra of tunnelling ND_4^+ ion.** Lalowicz, Z.T. (Institute of Nuclear Physics, Krakow (Poland)); Sobol, W.T. (Uniwersytet Slaski, Katowice (Poland). Inst. Fizyki). 1980. (In Polish). NTIS (US Sales Only), PC A13/MF A01. Order Number DE84780233. (CONF-791295—). TI84780233

From 12. national seminar on nuclear magnetic resonance and its applications; Cracow, Poland (3 Dec 1979).

28910 (INP—1080/PL, pp 78-86) **Study of tetrahydrous potassium-sodium tartrate by NMR method in 205K and 273K.** Holderna-Matuszkiewicz, K.; Parlinski, M. (Uniwersytet Adama Mickiewicza, Poznan (Poland). Inst. Fizyki). 1980. (In Polish). NTIS (US Sales Only), PC A13/MF A01. Order Number DE84780233. (CONF-791295—). TI84780233

From 12. national seminar on nuclear magnetic resonance and its applications; Cracow, Poland (3 Dec 1979).

The studies of the dependence of the second moment of NMR spectra line on orientation of Seignette salt crystal in magnetic field in ferroelectric state (273K) as well as in para or antiferroelectric state (205K) were carried out. The proposed structure model in low temperature phase was presented.

28911 (INP—1080/PL, pp 54-63) **Second moments of NMR spectra line in diamagnetic and paramagnetic fluoroperovskites type NH_4MeF_3.** Pajak, Z.; Majewska, I. (Uniwersytet Adama Mickiewicza, Poznan (Poland). Inst. Fizyki). 1980. (In Polish). NTIS (US Sales Only), PC A13/MF A01. Order Number DE84780233. (CONF-791295—). TI84780233

From 12. national seminar on nuclear magnetic resonance and its applications; Cracow, Poland (3 Dec 1979).

The second moments of NMR spectra line in diamagnetic and paramagnetic fluoroperovskites type NH_4MeF_3 were measured to analyze the character of interactions of protons of ammonium group with diamagnetic or paramagnetic central ions. The temperature dependence of the second moments of NMR spectra line is presented.

28912 (INP—1080/PL, pp 64-71) **Investigations of the second moment of NMR spectra line in solid solutions of fluoroperovskites $NH_4Cosub(x)Mgsub(1-x)F_3$.** Pajak, Z.; Kapturczak, J.; Osten, H.J. (Uniwersytet Adama Mickiewicza, Poznan (Poland). Inst. Fizyki). 1980. (In Polish). NTIS (US Sales Only), PC A13/MF A01. Order Number DE84780233. (CONF-791295—). TI84780233

From 12. national seminar on nuclear magnetic resonance and its applications; Cracow, Poland (3 Dec 1979).

The second moment of NMR spectra line was investigated to get to know the mechanisms of nuclear and electronic spins interactions in well-ordered and bad-ordered magnetic phase of solid solutions of fluoroperovskites $NH_4Cosub(x)Mgsub(1-x)F_3$.

28913 (INP—1080/PL, pp 190-194) **Application of T_1 relaxation times to studies of intermolecular interactions between $Cr/AcAc/_3$ and ^{31}P atom in ethyl esters of phosphor acids.** Ejchart, A.; Wroblewski, K. (Polska Akademia Nauk, Lodz. Centrum Badan Molekularnych i Makromolekularnych); Oleski, P. (Politechnika Lodzka (Poland)). 1980. (In Polish). NTIS (US Sales Only), PC A13/MF A01. Order Number DE84780233. (CONF-791295—). TI84780233

From 12. national seminar on nuclear magnetic resonance and its applications; Cracow, Poland (3 Dec 1979).

The measurements of relaxation times were carried out on BROKER HX-72 spectrometer at resonance frequency of ^{31}P nucleus 36.43 MHz. The theory Gierer-Wirtz was used to quantitative description of intermolecular dipole interactions between model phosphor compounds and $Cr/AcAc/_3$. The results were elaborated by the least square method using NICOLET minicomputer.

28914 (JINR-R—3-83-133) **Direct calculation of the probabilities of magnetic dipole transitions for the three-vealent rare earth ions in the crystalline electric field with hexagonal symmetry.** Myule, Eh. (Joint Inst. for Nuclear Research, Dubna (USSR) Lab. of Neutron Physics). 1983. 14p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE84701674.

Direct calculation of the probabilities of magnetic dipole transitions for the three valent rare earth ions in the crystalline electric field with hexagonal symmetry has been carried out. These transition probabilities will be applied to the calculations of the line intensities of the inelastic neutron scattering spectra of rare earth ions. In these calculations the symmetry properties of the Hamiltonian of 4f-electrons in the hexagonal crystalline electric field are used. This provides a reduction of the degree of the secular equation, which would be not more than three for every rare earth ion. This direct estimate of the energies and transition probabilities yields a considerable reduction of the computer time in the fit procedure of the experimental spectra using parameters of the crystalline electric field. The wave functions, the energy levels, and the transition probabilities are given in the tables.

28915 (K/PS—5020) **Densities of dilute uranium hexafluoride solutions.** Hedge, W.D. (Oak Ridge Gaseous Diffusion Plant, TN (USA)). May 1984. Contract AC05-84OT21400. 13p. NTIS, PC A02/MF A01; GPO Dep. Order Number DE84012393.

Solution densities of binary solutions of the solutes hydrogen fluoride, dichlorotetrafluoroethane, trichlorotrifluoroethane, trichloroheptafluorobutane, and perfluorodimethylcyclohexane in the solvent uranium hexafluoride were measured at 70°C. The solution densities obtained indicate the solutions to be nonideal. Calculated apparent molar volumes of the solute and solvents, and the molal weight of the solvent, are included.

28916 (LBL—17579) **Surface chemistry of large hydrocarbon and small inorganic molecules on Os(001) and Ru(001).** Shanahan, K.L. (Lawrence Berkeley Lab., CA (USA)). Apr 1984. Contract AC03-76SF00098. 191p. NTIS, PC A09/MF A01; 1; GPO Dep. Order Number DE84012164.

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The surface chemistry of five general classes of compounds has been investigated on the flat, hexagonally close-packed Os(001)

and Ru(001) surfaces. The five classes were: (1) small inorganic molecules; (2) benzene and its derivatives; (3) heteroaromatics; (4) inorganic and organic cyanides; and (5) oxygen-containing hydrocarbons. Studies were conducted both at room and low temperature with thermal desorption mass spectrometry, low energy electron diffraction, and Auger electron spectroscopy. In general, the chemistry displayed on these surfaces after adsorption at room temperature was quantitative decomposition, except for the small inorganic molecules, and hydrogen cyanide, cyanogen, and trifluoroacetonitrile. Adsorption at low temperature often led to the appearance of new but weak molecular desorptions, however, the major process observed was still decomposition. Aspects of the decomposition processes of certain molecules have been elucidated by utilizing isotopic labelling and by comparing the decomposition of series of homologous compounds.

28917 **(NUREG/CR—3514) Chemical behavior of iodine in aqueous solutions up to 150°C. I. An experimental study of nonredox conditions.** Toth, L.M.; Pannell, K.D.; Kirkland, O.L. (Oak Ridge National Lab., TN (USA)). Apr 1984. Contract AC05-84OR21400. 48p. (ORNL/TM—8664). NTIS, PC A03/MF A01; 1 - GPO; GPO Dep. Order Number DE84010344.

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The chemical behavior of iodine, I_2, in (pH = 6 to 10) aqueous solutions containing 2500 ppM boron as H_3BO_3 (0.231 M) was studied at temperatures up to 150°C. Absorption spectrophotometry was used to identify and monitor the iodine species present. The I_2 hydrolysis chemistry was found to be consistent with the two-stage mechanism: $I_2 + H_2O$ reversible $HOI + H^+ + I^-$, 3 HOI reversible $IO_3^- + 2I^- + 3H^+$, where the intermediate species is designated as HOI to emphasize that its exact structure and composition are not defined. Three objectives were considered: (1) species identification, with special attention given to HOI; (2) the kinetics of reaction between iodine and water to produce iodide and iodate ions; and (3) partition coefficients between liquid and vapor phases for individual iodine species. Kinetic rate constants for the disproportionation of the HOI intermediate were measured. A typical activation energy for this reaction was found to be 28.4 kJ/mol (6.8 kcal/mol). Although some initial results had suggested an ionic strength dependency, a more detailed examination of the ionic strength effect on this disproportionation reaction suggests that the intermediate in solution throughout the pH 7 to 10 range is primarily an uncharged species such as the triatomic HOI. No absorption bands can be assigned to the HOI intermediate even though it has been shown, in some cases, to be present at concentrations of $\geq 1 \times 10^{-3}$ M. A very low molar absorptivity ($< 10\ M^{-1}\ cm^{-1}$) is probably responsible for its undetectability. A partition coefficient of $> 1 \times 10^4$ has been estimated for HOI.

28918 (ORNL—6021, pp 20-22) **X-ray diffraction.** Wei, C.H. Jan 1984. NTIS, PC A12/MF A01. Order Number DE84006248. TI84006248

In Biology Division. Progress report, August 1, 1982-September 30, 1983.

Cis-Diamminedichloroplatinum(II) (cis-DDP) is known to be a clinically effective antitumor drug. The binding of cis-DDP to DNA by intercalation is presumably responsible for its selective cytotoxicity. Molecular configurations of cis-DDP-like complexes involving nucleoside are important in understanding the structure-function relationships. A compound of presumed formula $Pt(Ado.Cl_2)$ was prepared by the reaction of K_2PtCl_4 with adenosine. Useful untwinned crystals (I) were obtained from a solution of 1,2-dichloroethane. When complex I was further treated with pyridine and DMSO, large colorless crystals were obtained (II). Subsequent structural analyses by x-ray diffractin have shown complex I to be trans-dichloro(dipyridine)platinum(II) and complex II to be tetrapyridineplatinum(II) dichloride trihydrate. As expected, the Pt^{2+} ion possesses a typical square-planar configuration in each case with Pt^{2+} coordinated to two Cl^- and two N atoms of pyridine ligands in complex I, and to four N atoms of pyridine molecules in complex II.

28919 **(SAND—84-0236) XPS examination of Cr(V) compounds.** Rogers, J.W. Jr.; Ward, S.J.; Guidotti, R.A. (Sandia National Labs., Albuquerque, NM (USA)). Apr 1984. Contract AC04-76DP00789. 12p. NTIS, PC A02/MF A01; GPO Dep. Order Number DE84012896.

X-ray photoelectron spectroscopy (XPS) was used to study the oxidation state of Cr in $Ca_5(CrO_4)_3Cl$ and Ca_3CrO_4Cl, which are being evaluated for use as cathodes in thermal batteries. The measured binding energies of Cr(V) in these compounds are 579.5 and 579.0 eV, respectively, which are intermediate between those for Cr(III) and Cr(VI). XPS was also evaluated as an investigative tool for monitoring the oxidation state of Cr during the discharge of Cr(V) compounds used as cathodes in thermal batteries.

28920 **Absence of $I(^2P_1/sub\ //_2)$ as a product of the reactions of F atoms with HI, I_2, and ICN.** Das, P.; Venkitachalam, T.; Bersohn, R. (Department of Chemistry, Columbia University, New York, New York 10027). *Journal of Chemical Physics;* **80**: No. 10, 4859-4862(15 May 1984).

It is shown by two photon laser induced fluorescence that virtually no $I(^2P_1/sub\ //_2)$ atoms are products of the reactions of F atoms with HI, I_2, and ICN. A simple electrostatic model is used to prove that the potential surface beginning at $F^*(^2P_1/sub\ //_2)+RI$ and ending at $RF+I^*(^2P_1/sub\ //_2)$ must have an intermediate maximum. Moreover, this surface must cross a surface leading to ground state I atoms at two points. It is concluded that the propensity to form I rather than I* atoms is not general but depends on specific properties of the potential surfaces.

28921 **Shock tube study of the thermal decomposition of cyanogen.** Szekely, A.; Hanson, R.K.; Bowman, C.T. (High Temperature Gasdynamics Laboratory, Department of Mechanical Engineering, Stanford University, Stanford, California 94305). *Journal of Chemical Physics;* **80**: No. 10, 4982-4985(15 May 1984).

The thermal decomposition of cyanogen behind incident shock waves has been studied in the temperature range 2500—3450 K, at pressures between 0.23 and 0.58 bar. The course of the reaction was followed by monitoring the CN ($B\ ^2\Sigma^+$, v = 0←$X\ ^2\Sigma^+$, v = 0) absorption at 388 nm. The low-pressure rate coefficient for the reaction $C_2N_2+Ar \rightarrow 2CN+Ar$ was fitted by the Arrhenius expression k_1 = 10/sup 16.8plus-or-minus0.17/ exp[-(50 040 +- 1070)/T]cm³/mol s. Comparisons of the present work with previously published results are discussed.

28922 **Excited-state spectra and lifetimes for oxomethoxomolybdenum(V) tetraphenylporphine: a comparison of d/sup 1/ and d/sup 9/ metalloporphyrin photophysics.** Serpone, N. (Brookhaven National Lab., Upton, NY); Ledon, H.; Netzel, T.L. *Inorganic Chemistry;* **23**: No. 4, 454-457(15 Feb 1984). Contract AC02-76CH00016.

The d/sup 1/ metalloporphyrin oxomethoxomolybdenum(V) tetraphenylporphine [OMo(TPP)OCH_3] was studied in tetrahydrofuran by picosecond absorption spectroscopy using a double-beam mode-locked Nd:glass laser system delivering 6-ps (fwhm) pulses at 527 nm with 1-2mJ/pulse. Change in absorbance (ΔA) spectra were recorded from the time of photoexcitation to 5 ns after excitation in the 580-740-nm region. Two transient species were observed with lifetimes of 2-9 ps and 4 +/- 1 ns. The first relaxation is assigned to the establishment of the $[^3T_1(\pi,\pi^*) \rightleftharpoons {}^1T_1(\pi,\pi^*)$ equilibrium and the second to the radiationless decay of the $[^3T_1(\pi,\pi^*) \rightleftharpoons {}^1T_1(\pi,\pi^*)]$ equilibrium of states. The initially populated $^1S_1(\pi,\pi^*)$ state is known to be emissionless in Mo(V) porphyrins and was not observed, tau < 2 ps. These results and assignments are then compared with those of other S = 1/2 metalloporphyrins, i.e., d^9 copper(II) and silver(II) porphyrins.

28923 **Dimerization of aquadioxovanadium(V) ion in concentrated perchloric and sulfuric acid media.** Madic, C.; Begun, G.M.; Hahn, R.L.; Launay, J.P.; Thiessen, W.E. (Oak Ridge National Lab., TN). *Inorganic Chemistry;* **23**: No. 4, 469-476(15 Feb 1984). Contract W-7405-ENG-26.

The aquadioxovanadium(V) ion was found to give a dimer with a central $V_2O_3^{4+}$ group in concentrated $HClO_4$ and H_2SO_4 media. Evidence for dimerization was obtained by UV-visible,

Raman, and NMR spectroscopy, X-ray scattering, and cyclic voltammetry. The mass action law constant of the dimerization reactions is equal to 1.54 M^{-1} for 11.8 M $HClO_4$ and 83 M^{-1} for 10 M H_2SO_4. Vanadium(V) exists in the pure dimeric form for a H_2SO_4 concentration range of 13-16 M. Raman and X-ray scattering indicate the dimer structure is of a type with a nonlinear oxygen bridge and a V-V distance of 3.25 A. ^{51}V NMR is also consistent with this formulation. The vanadium(V) dimer in H_2SO_4 medium exhibits a reversible redox behavior on polished platinum and glassy carbon electrodes. In 13-16 M H_2SO_4 media, a large increase in vanadium concentration or an increase in temperature leads to a further polymerization step to form a soluble species with a long V-O-V-O-V- chain. Vanadium(V) and neptunium(V) dimers are compared.

28924 **Studies of the reactions of group 8 transition-metal ions Fe^+, Co^+, and Ni^+ with linear alkanes. Determination of reaction mechanisms and MC/sub n/H/sub 2n/$^+$ ion structures using Fourier transform mass spectrometry collision-induced dissociation.** Jacobson, D.B.; Freiser, B.S. (Purdue Univ., West Lafayette, IN). *Journal of the American Chemical Society;* **105**: No. 16, 5197-5206(10 Aug 1983). Contract AC02-80ER10689.

With use of Fourier transform mass spectrometry, the ion products resulting from the reactions of the group 8 transition-metal ions Fe^+, Co^+, and Ni^+ with a variety of hydrocarbons were studied by both collision-induced dissociation and specific ion-molecule reactions. Evidence is provided for four unique $MC_4H_8^+$ structures. All three metal ions dehydrogenate linear alkanes larger than propane via initial insertion into C-C bonds resulting in the formation of bis(olefin)-metal ion complexes. In addition, Fe^+ also dehydrogenates linear alkanes via initial insertion into C-H bonds, producing an olefin-metal ion complex. β-Hydride transfers are more facile for Co^+ than either Fe^+ or Ni^+. Secondary β-hydride transfers are more facile than primary β-hydride transfers for both Co^+ and Ni^+; however, the reverse is observed for Fe^+. Both Co^+ and Ni^+ are highly selective against insertion into terminal C-C bonds, with Fe^+ showing considerably less selectivity. Formation of $MC_4H_6^+$ ions from linear alkanes larger than butane occurs via initial alkane loss producing a metal ion-butene complex followed by dehydrogenation.

28925 **Elemental sulfur and selenium induced intramolecular carbyne-carbyne coupling in trinuclear bis(carbyne) cobalt clusters. A novel entry into metalladithiolenes and metalladiselenolenes.** Vollhardt, K.P.C. (Univ. of California, Berkeley); Walborsky, E.C. *Journal of the American Chemical Society;* **105**: No. 16, 5507-5509(10 Aug 1983). Contract AC03-76SF00098.

Sulfur is not only an undesirable pollutant in coal and petroleum but is also detrimental to fuel-related catalytic processes such as hydrocarbon reforming and Fischer-Tropsch synthesis. While homogeneous transition-metal complexes have been studied as potential models for hydrodesulfurization processes and for sulfur-sulfur interactions, none have specifically probed the reactivity of sulfur with respect to carbon-based potential surface analogues. We report that μ_3-ν-carbyne ligands couple intramolecularly in the coordination sphere of trinuclear cobalt clusters when exposed to elemental sulfur (and selenium) to provide a novel, efficient synthetic entry into ν^5-cyclopentadienylcobaltadithiolenes and selenolenes.

28926 **(LA-tr—83-12) Reaction of various metal oxides with hydrogen chloride and the reverse reactions.** Kasaoka, Shigeaki; Sakata, Yusaku; Shirata, Masahisa. Translated from *Nippon Kagaku Kaishi ;* No. 11, 1728-1736(1977). Contract W-7405-ENG-36. 19p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE84012220. DE84012220

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Subjects of investigations were methods of precipitation of transient metal oxides (single- and multiple-component systems), chloride formation reactions and decomposition of chlorides with O_2 and water vapor. The results revealed that bivalent metal oxides showed a chlorine absorption mode of the reaction, whereas metal oxides with valency more than three showed a chlorine release mode of the process. 9 figures, 4 tables.

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REFER ALSO TO CITATION(S) 28885, 28892, 28893, 28895, 28915, 28925, 28964

28927 **(AD-A—953028/8) Benzothiophene chemistry. 5. The pyrolysis of benzothiophene 1-dioxide. Technical report.** Bordwell, F.G.; McKellin, W.H.; Babcock, D. (Northwestern Univ., Evanston, IL (USA). Chemical Lab.). Apr 1951. 15p. (TR—2). NTIS, PC A02/MF A01.

No abstract available.

28928 **(BNL—34673) Use of the neutron diffraction - H/D exchange technique to determine the conformational dynamics of trypsin.** Kossiakoff, A.A. (Brookhaven National Lab., Upton, NY (USA)). 1982. Contract AC02-76CH00016. 24p. (CONF-8206240—6). NTIS, PC A02; 3; GPO Dep. Order Number DE84012217.

From Brookhaven symposium biology 32; Upton, NY, USA (1 Jun 1982).

Paper copy only, copy does not permit microfiche production.

Reported here are studies analyzing the extent and nature of the inherent conformational fluctuations in trypsin by neutron diffraction - hydrogen exchange techniques. The pattern of exchange investigates systematic relationships between exchangeable sites and the structural and chemical properties of the molecule. Our findings that pH 7, 20° and 1 year of soaking all sites of trypsin are fully exchanged except those which are especially well protected by the structure. Essentially all the sites in which the peptide hydrogens are bonded directly to water molecules - either in the bulk solvent regions or in interior clusters - are fully exchanged. 41 references, 10 figures.

28929 (INP—1080/PL, pp 137-141) **Aspects of reaction of N-oxide radical with ethers in ^{13}C NMR spectrum.** Kolodziejski, W. (Warsaw Univ. (Poland)). 1980. (In Polish). NTIS (US Sales Only), PC A13/MF A01. Order Number DE84780233. (CONF-791295—). TI84780233

From 12. national seminar on nuclear magnetic resonance and its applications; Cracow, Poland (3 Dec 1979).

The stable radical N-oxide 2,2,6,6-tetramethylpiperidine was dissolved in ethers. The ^{13}C NMR spectra were recorded in the temperature 313K at the frequency 22,625 MHz on the spectrometers with Fourier transformation. The dissolution of the radical in ether caused the contact shifts in NMR spectra. The shifts were measured.

28930 (INP—1080/PL, pp 40-47) **Influence of anion on molecular dynamics of guanidine salts.** Grottel, M. (Akademia Rolnicza, Poznan (Poland)); Pajak, Z. (Uniwersytet Adama Mickiewicza, Poznan (Poland). Inst. Fizyki). 1980. (In Polish). NTIS (US Sales Only), PC A13/MF A01. Order Number DE84780233. (CONF-791295—). TI84780233

From 12. national seminar on nuclear magnetic resonance and its applications; Cracow, Poland (3 Dec 1979).

Molecular dynamics of guanidine ions was investigated by measurement of temperature dependences of the second moments of NMR lines and spin-lattice relaxation times to discover hypothetical existing reorientations and to ascertain their expected dependences on anion.

28931 (INP—1080/PL, pp 9-12) **Investigation of triproton groups mobility by measuring angular dependence of relaxation time T_1 in triglicine sulfate monocrystal.** Idziak, S.; Slosarek, G.; Pislewski, N. (Polska Akademia Nauk, Poznan. Inst. Fizyki Molekularnej). 1980. (In Polish). NTIS (US Sales Only), PC A13/MF A01. Order Number DE84780233. (CONF-791295—). TI84780233

From 12. national seminar on nuclear magnetic resonance and its applications; Cracow, Poland (3 Dec 1979).

The mobility of triproton groups in triglycine sulfate monocrystal is studied by nuclear magnetic resonance. The results of

measuring angular dependence of relaxation time T_1 as well as theoretical data are presented.

28932 (INP—1080/PL, pp 145-149) **Study of regioselectivity of reaction of donor centres of enamines R_1-C_1O-C_2 = C_3-NHR_2 using NMR.** Kozerski, L.; Czerwinska, E. (Polska Akademia Nauk, Warsaw. Inst. Chemii Organicznej). 1980. (In Polish). NTIS (US Sales Only), PC A13/MF A01. Order Number DE84780233. (CONF-791295—). TI84780233

From 12. national seminar on nuclear magnetic resonance and its applications; Cracow, Poland (3 Dec 1979).

The regioselectivity of reaction of donor centres of enamines was studied using NMR method. The intramolecular process in the molecule 2H-1,5-benzodioxepine is presented. The values of chemical shifts from ^{13}C spectra are given.

28933 (INP—1080/PL, pp 124-129) **Influence of monosubstituted aromatic solvents on propionitrile NMR shift.** Bednarek, E.; Jackowski, K. (Warsaw Univ. (Poland)). 1980. (In Polish). NTIS (US Sales Only), PC A13/MF A01. Order Number DE84780233. (CONF-791295—). TI84780233

From 12. national seminar on nuclear magnetic resonance and its applications; Cracow, Poland (3 Dec 1979).

The NMR spectrum of propionitrile CH_3CH_2CN is given. The influence of monosubstituted aromatic solvents on screening of ^1H of propionitrile is presented.

28934 (INP—1080/PL, pp 48-53) **Molecular motions in polyethylene glycols. Part 2.** Glowinkowski, S.; Pajak, Z. (Uniwersytet Adama Mickiewicza, Poznan (Poland). Inst. Fizyki). 1980. (In Polish). NTIS (US Sales Only), PC A13/MF A01. Order Number DE84780233. (CONF-791295—). TI84780233

From 12. national seminar on nuclear magnetic resonance and its applications; Cracow, Poland (3 Dec 1979).

The temperature measurements of spin-lattice relaxation time in rotating system of coordinates were carried out to obtain more complete information about the molecular motions in polyethylene glycols of molecular weight 5000. The impulse NMR spectrometer was used /field H_1 = 18.4Gs for polyethylene glycol of molecular weight 5000./ The obtained results are given.

28935 (INP—1080/PL, pp 130-136) **Temperature dependence of screening of ^{13}C nuclei in simple aliphatic alcohols.** Jackowski, K. (Warsaw Univ. (Poland)); Raynes, W.T. (Sheffield Univ. (UK). Dept. of Chemistry). 1980. (In Polish). NTIS (US Sales Only), PC A13/MF A01. Order Number DE84780233. (CONF-791295—). TI84780233

From 12. national seminar on nuclear magnetic resonance and its applications; Cracow, Poland (3 Dec 1979).

^{13}C NMR spectra of alcohols were recorded on the high resolution spectrometer. The temperature dependence of screening of ^{13}C nuclei in methanol, ethanol and isopropanol is presented.

28936 (INP—1080/PL, pp 174-181) **Study of anisotropy of α,ω-dichloroderivatives n-paraffins.** Peplinska, B.; Pajak, Z. (Uniwersytet Adama Mickiewicza, Poznan (Poland). Inst. Fizyki). 1980. (In Polish). NTIS (US Sales Only), PC A13/MF A01. Order Number DE84780233. (CONF-791295—). TI84780233

From 12. national seminar on nuclear magnetic resonance and its applications; Cracow, Poland (3 Dec 1979).

The molecular dynamics of α,ω-chloroderivatives n-paraffins was studied by nuclear magnetic relaxation. The usefulness of known theoretical models to description of motion anisotropy was checked. The temperature dependence of spin-lattice relaxation time is given.

28937 (INP—1080/PL, pp 160-167) **Dipole relaxation theory in multispin systems.** Blicharski, J.S. (Uniwersytet Jagiellonski, Krakow (Poland). Inst. Fizyki; Institute of Nuclear Physics, Krakow (Poland)). 1980. (In Polish). NTIS (US Sales Only), PC A13/MF A01. Order Number DE84780233. (CONF-791295—). TI84780233

From 12. national seminar on nuclear magnetic resonance and its applications; Cracow, Poland (3 Dec 1979).

The time of dipole relaxation is calculated for the system of multispin 1/2 in chain molecular structure. The dipole relaxation for alkanes is considered. The relaxation of the last groups CH_3 which may constitute relaxation centres in a case when the chain structure is not flexible is studied.

28938 (INP—1080/PL, pp 72-77) **Study of molecular dynamics of polycrystalline thiourea by NMR method under hydrostatic pressure.** Klimowski, J. (Uniwersytet Adama Mickiewicza, Poznan (Poland). Inst. Fizyki). 1980. (In Polish). NTIS (US Sales Only), PC A13/MF A01. Order Number DE84780233. (CONF-791295—). TI84780233

From 12. national seminar on nuclear magnetic resonance and its applications; Cracow, Poland (3 Dec 1979).

The influence of hydrostatic pressure to 5 kbar on molecular dynamics of polycrystalline thiourea in temperatures 285K and 299K was investigated. The dependence of the second moment of NMR spectra line of thiourea on hydrostatic pressure is presented.

28939 (INP—1080/PL, pp 182-189) **Proton spin-lattice relaxation in natural biological membranes systems.** Blicharski, J.S.; Haranczyk, H. (Uniwersytet Jagiellonski, Krakow (Poland). Inst. Fizyki); Strzalka, K. (Uniwersytet Jagiellonski, Krakow (Poland)). 1980. (In Polish). NTIS (US Sales Only), PC A13/MF A01. Order Number DE84780233. (CONF-791295—). TI84780233

From 12. national seminar on nuclear magnetic resonance and its applications; Cracow, Poland (3 Dec 1979).

The measurements of the temperature dependence of the times of proton spin-lattice relaxation are used to study phase dynamics of natural biological membranes.

28940 (INP—1080/PL, pp 204-208) **Phase transformations in pentachlorophenol and in binary system: pentachlorophenol-hexachlorobenzene.** Radomski, R. (Politechnika Wroclawska (Poland). Inst. Chemii Organicznej i Fizycznej); Gallier, J. (Rennes-1 Univ., 35 (France)). 1980. (In Polish). NTIS (US Sales Only), PC A13/MF A01. Order Number DE84780233. (CONF-791295—). TI84780233

From 12. national seminar on nuclear magnetic resonance and its applications; Cracow, Poland (3 Dec 1979).

The phase transformations in pure pentachlorophenol and in binary system: pentachlorophenol-hexachlorobenzene were studied using NMR spectroscopy methods. The measurements of NMR spectra and relaxation times were carried out on Brulker SXP-4/100 spectrometer at frequency 90 MHz.

28941 (INP—1080/PL, pp 214-220) **Use of T_1 relaxation times and Overhauser effect of ^{13}C and ^{31}P nuclei to study molecules reorientation and intramolecular motions of phosphororganic compounds.** Ejchart, A.; Wroblewski, K. (Polska Akademia Nauk, Lodz. Centrum Badan Molekularnych i Makromolekularnych); Oleski, P. (Politechnika Lodzka (Poland)). 1980. (In Polish). NTIS (US Sales Only), PC A13/MF A01. Order Number DE84780233. (CONF-791295—). TI84780233

From 12. national seminar on nuclear magnetic resonance and its applications; Cracow, Poland (3 Dec 1979).

The results obtained for chosen phosphoorganic compounds are presented. The most of them concern relaxation of ^{13}C nucleus. The measured T_1 relaxation times are given.

28942 (INP—1080/PL, pp 242-250) **Preliminary studies of the phenomenon of checked rotation in 4-X-substituted-1-/N-alkylo-N-acylo-amino/naphtalenes molecules.** Kleps, J.; Skulski, L.; Wybraniec-Bugaj, J. (Akademia Medyczna, Warsaw (Poland)). 1980. (In Polish). NTIS (US Sales Only), PC A13/MF A01. Order Number DE84780233. (CONF-791295—). TI84780233

From 12. national seminar on nuclear magnetic resonance and its applications; Cracow, Poland (3 Dec 1979).

The influence of the substituents in 4 position of naphthalene ring on rotational barrier around Csub(1Ar)-N band was studied using nuclear magnetic resonance. The temperature dependent

NMR spectra are given. They were recorded on "Tesla" BS487C spectrometer.

28943 (INP—1080/PL, pp 251-256) **Role of configuration entropy in association process of aliphatic alcohols solutions.** Pasterna, G.; Kluk, H.; Wilk, E.; Sobol, W. (Uniwersytet Slaski, Katowice (Poland). Inst. Fizyki). 1980. (In Polish). NTIS (US Sales Only), PC A13/MF A01. Order Number DE84780233. (CONF-791295—). TI84780233

From 12. national seminar on nuclear magnetic resonance and its applications; Cracow, Poland (3 Dec 1979).

In the frames of alcohols association studies the chemical shifts of hydroxy protons of alcohols series in carbon disulfide were measured on NMR BS-487 spectrometer in the temperature range +5°C to +45°C.

28944 (INP—1080/PL, pp 257-261) **Influence of substitution on chemical shifts C-13 in alkyl derivatives.** Ejchart, A. (Polska Akademia Nauk, Lodz. Centrum Badan Molekularnych i Makromolekularnych). 1980. (In Polish). NTIS (US Sales Only), PC A13/MF A01. Order Number DE84780233. (CONF-791295—). TI84780233

From 12. national seminar on nuclear magnetic resonance and its applications; Cracow, Poland (3 Dec 1979).

The chemical shifts in the chosen group of primary and secondary aliphatic alcohols as well as in their acetates, trichloroacetates and ethyl ethers were analyzed. The chemical shifts in primary and secondary carboxylic acids and in their methyl esters were studied too.

28945 (INP—1080/PL, pp 262-264) **NMR studies of molecular complexes forming between pyridine bases and t-butyl alcohol.** Waclawek, W.; Domagala, A. (Wyzsza Szkola Pedagogiczna, Czestochowa (Poland)). 1980. (In Polish). NTIS (US Sales Only), PC A13/MF A01. Order Number DE84780233. (CONF-791295—). TI84780233

From 12. national seminar on nuclear magnetic resonance and its applications; Cracow, Poland (3 Dec 1979).

The stoichiometric composition of complexes of pyridine bases with t-butyl alcohol in benzene was determined by dielectric methods. The stability constants of pyridine bases with t-butyl alcohol were determined by NMR method. Their values depend on the position of methyl group in the studied base.

28946 (INP—1080/PL, pp 265-268) **NMR studies of molecular complexes forming between purine and pyrimidine bases and erythrite tetranitrate.** Urbanski, T. (Politechnika Warszawska (Poland)); Waclawek, W.; Poblocka, K. (Wyzsza Szkola Pedagogiczna, Czestochowa (Poland)). 1980. (In Polish). NTIS (US Sales Only), PC A13/MF A01. Order Number DE84780233. (CONF-791295—). TI84780233

From 12. national seminar on nuclear magnetic resonance and its applications; Cracow, Poland (3 Dec 1979).

The results of the NMR studies on stoichiometric composition stability constants and enthalpy of complexes forming between purine and pyrimidine bases and erythrite are given.

28947 (INP—1080/PL, pp 269-273) **NMR studies of molecular complexes forming between some benzene derivatives and 2,4,6-trinitrotoluene.** Waclawek, W.; Poblocka, K.; Slawuta, U.; Idzikowska, J. (Wyzsza Szkola Pedagogiczna, Czestochowa (Poland)). 1980. (In Polish). NTIS (US Sales Only), PC A13/MF A01. Order Number DE84780233. (CONF-791295—). TI84780233

From 12. national seminar on nuclear magnetic resonance and its applications; Cracow, Poland (3 Dec 1979).

The stoichiometric composition and stability constants of molecular complexes forming between some benzene derivatives and 2,4,6-trinitrotoluene were determined by NMR method. The obtained results are compared with the results of others.

28948 (K/PS—773) **Determination of evaporation rates of organic solvents by thin-film evaporometer.** Headrick, A.K. (Oak Ridge Gaseous Diffusion Plant, TN (USA)). May 1984. Contract AC05-84OT21400. 17p. NTIS, PC A02/MF A01; GPO Dep. Order Number DE84012308.

An automatic thin-film evaporometer was used to determine evaporation rates of volatile organic solvents. The instrument measures weight loss as a function of time under specific environmental conditions. The method, ASTM D 3539, is limited only in that the sample should not be too viscous so as to allow dispensing with a syringe. The rate of evaporation can be valuable information in optimizing processes involving application of materials containing volatile solvents.

28949 **Time dependent reactivity of species embedded in micelles: Lifetime distribution of photoproduced N,N,N′,N′-tetramethylbenzidine cation radicals in sodium dodecyl sulfate micelles.** Plonka, A.; Kevan, L. (Department of Chemistry, University of Houston, Houston, Texas 77004). *Journal of Chemical Physics;* **80**: No. 10, 5023-5026(15 May 1984).

Photoproduced N,N,N′,N′-tetramethylbenzidine cation radicals in sodium dodecyl sulfate micelles decay in a pseudo-first-order reaction with an apparent rate constant k(t) depending on time according to k(t) = Bt/sup alpha-1/ , where B and $\alpha(0<\alpha<$ or $=1)$ are constants. At a given temperature the numerical value of B decreases with the storage time between preparation of the micellar solution and photoionization achieving a constant value for a storage time of a few days. The numerical value of α is essentially independent of the storage time and determines the distribution of cation radical lifetimes for a given value of B.

28950 **Decomposition of methanol, formaldehyde, and formic acid on nonpolar (1010), stepped (5051), and (0001) surfaces of ZnO by temperature-programmed decomposition.** Akhter, S.; Cheng, W.H.; Lui, K.; Kung, H.H. (Northwestern Univ., Evanston, IL). *Journal of Catalysis;* **85**: No. 2, 437-456(Feb 1984).

The decomposition of methanol, formaldehyde, and formic acid were studied on a nonpolar (1010), a stepped (5051) and a Zn polar (0001) surface by temperature-programmed decomposition. The decomposition products on the (1010) and (5051) surfaces were similar, but the coverage and the amounts of products were consistently higher on the (5051) surface. Two pathways for decomposition of methanol are proposed, dissociatively adsorbed oxygen at 150°C and oxidation of methoxide to a surface formate-like species. Formaldehyde and formic acid also decomposed via the surface formate. The competition between dehydrogenation and oxidation depended on the coverage such that dehydrogenation was more favored for higher coverages. Decomposition products were identified for the two pathways for the different compounds. Desorption of all the decomposition products wasreaction-limited except for water which was desorption-limited. The results indicated that the (0001) surface is more metallic in its behavior than the (1010) and (5051) surfaces. Comparison of the desorption temperatures of different compounds suggests that at room temperature, alcohols adsorb molecularly on the (0001) surface but dissociatively on the other two surfaces. On the (0001), comparison among methanol, ethanol, and isopropanol suggests that the ease of dehydrogenation parallels the strength of the α/sub C-H/ bond.

28951 **Kinetics of vapor-phase electrochemical oxidative dehydrogenation of ethylbenzene.** Michaels, J.N.; Vayenas, C.G. (Massachusetts Inst. of Tech., Cambridge). *Journal of Catalysis;* **85**: No. 2, 477-487(Feb 1984). Contract AC02-80ER10694.

The vapor-phase electrochemical oxidative dehydrogenation of ethylbenzene to styrene was studied at 575°C and atmosperhic pressure on a polycrystalline platinum electrocatalyst in a stabilized zirconia electrochemical reactor. Electrochemical supply of oxygen to the electrocatalytic surface increases both the dehydrogenation rate and the deep oxidation rate. Carbon dioxide formation is oxygen-limited and its rate is linear in current density. The dehydrogenation rate is enhanced as much as 600% by moderate current densities; this electrocatalytic enhancement reaches an ethylbenzene-concentration-dependent asymptote at larger current densities. Addition of gas-phase hydrogen suppresses both the deep oxidation rate and the current-induced increase of the dehydrogenation rate. A two-site Langmuir-Hinshelwood type reaction mechanism is proposed which quantitatively describes these results from a surface

oxidative dehydrogenation step in which adsorbed ethylbenzene reacts with oxidized surface sites to form styrene and water.

28952 **Synthesis of inequivalently bridged cyclopentadienyl dimers of molybdenum and a comparison of their reactivities with unsaturated molecules and with hydrogen.** McKenna, M.; Wright, L.L.; Miller, D.J.; Tanner, L.; Haltiwanger, R.C.; DuBois, M.R. *Journal of the American Chemical Society;* **105**: No. 16, 5329-5337(10 Aug 1983).

A series of dimeric cyclopentadienyl complexes of molybdenum which are bridged by two inequivalent dithiolate ligands have been synthesized. The new complexes include $(CpMo)_2(S_2CH_2)(SC_2H_4S)$, IVa, $(CpMo)_2(S_2C(CH_3)_2)(SC_2H_4S)$,IVb, $(Cp'Mo)_2(S_2CS)(SC_2H_4S)$, V, and $(CpMo)_2(SCHCPhS)(SC_2H_4S)$, VI (Cp = C_5H_5, Cp' = $CH_3C_5H_4$). The relative tendencies of the ethanedithiolate ligands to eliminate ethylene have been compared for the above series. The studies establish that the ligand lability is influenced by the nature of the other dithiolate bridge as well as by substituents on the cyclopentadienyl ligands. Alkynes and cumulenes react with the ethanedithiolate ligands in IV-VI to displace ethylene and form derivatives with unsaturated dithiolate bridges. Some of these unsaturated complexes can be hydrogenated under the mild conditions of 1-2 atm of H_2 at 60°C. The reactions result in the stoichiometric reduction of alkynes to cis-alkenes, allenes to alkenes, and ketenes to aldehydes. The relationship between hydrocarbon lability in the dithiolate ligands and hydrogenation activity is discussed. Two X-ray diffraction studies of complexes which contain a ν^2-μ-1,1-alkanedithiolate ligand have been completed. The acetylene adduct $(Cp'Mo)_2(S_2CH_2)(SC_2H_2S)$ crystallizes in space group $P2_1/c$ with a = 7.855 (2) A, b = 8.433 (2) A, C = 13.428 (3) A, and β = 104.61 (2)°. The methylated derivative $(Cp'Mo)_2(S_2CH_2)(SCH_3)_2$ crystallizes in space group Pbcn with a = 17.143 (4) A, b = 12.023 (2) A, and c = 8.931 (2) A. Structural parameters for these dimers are compared with those of other cyclopentadienylmolybdenum dimers with bridging thiolate ligands.

4005 Photochemistry

REFER ALSO TO CITATION(S) 28889

28953 **(CONF-830839—3) Structural aspects of molecular photoionization efficiency in micelles and vesicles as models for solar energy utilization.** Kevan, L. (Houston Univ., TX (USA). Dept. of Chemistry). 1983. Contract AS05-80ER10745. 6p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE84011837.

From Solar world congress; Perth, Australia (15 Aug 1983).
Portions are illegible in microfiche products.

The structural aspects controlling charge separation in molecular photoionization reactions in organized molecular assemblies involving micelles and vesicles are being studied by optical and electron magnetic resonance techniques including the time domain technique of electron spin echo modulation (ESEM). Photoionization of N,N,N',N'-tetramethylbenzidine (TMB) to give the cation radical has been carried out in both liquid and frozen micellar and vesicular solutions. Cation-water interactions have been detected by ESEM analysis and indicate that the cation is localized asymmetrically within these organized molecular assemblies. Stearic acid nitroxide spin probes have also been used to determine that the neutral TMB molecule before photoionization is also localized asymmetrically within such organized molecular assemblies. Electron spin echo detection of laser photogenerated TMB cation in liquid micellar solutions gives a direct measurement of the phase memory magnetic relaxation time which gives additional structural information. The relationship of this structural data to the efficiency of photoionization in these systems is discussed.

28954 **(CONF-840743—1) Solute-induced photo-ionization of nonpolar liquids.** McDonald, D.B.; Sauer, M.C. Jr. (Argonne National Lab., IL (USA)). 7 May 1984. Contract W-31-109-ENG-38. 6p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE84011700.

From 8. IEEE international conference on conduction and breakdown in dielectric liquids; Pavia, Italy (24 Jul 1984).
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Transient dc-conductivity measurements of anthracene solutions in cyclohexane have provided evidence for solvent ionization following irradiation with 248nm excimer laser pulses. A mechanisms resulting in a cyclohexane cation and an anthracene anion as near neighbors can explain the experimental observations: a high mobility species, 7-8 absorbed photons per solute molecule, intensity dependence, and absence of enhanced hydrogen generation. A photoionization apparatus with 20ps time resolution is being developed to observe transient ionization spectroscopically. Such a system may enable observation of solute-induced ionization in solvents having normal mobility cations.

28955 **(DOE/ER/10745—2) Charge separation in photoredox reactions. Technical progress report, May 1, 1981-May 1, 1984.** Kevan, L. (Houston Univ., TX (USA). Dept. of Chemistry). 1 May 1984. Contract AS05-80ER10745. 39p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE84011836.

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The structural aspects controlling charge separation in molecular photoionization reactions in organized molecular assemblies involving micelles and vesicles are being studied by optical and electron magnetic resonance techniques including the time domain technique of electron spin echo modulation (ESEM). Photoionization of N,N,N',N'-tetramethylbenzidine (TMB) to give the cation radical has been carried out in both liquid and frozen micellar and vesicular solutions. Cation-water interactions have been detected by ESEM analysis and indicate that the cation is localized asymmetrically within these organized molecular assemblies. x-Doxylstearic acid spin probes have been used to determine that the neutral TMB molecule before photoionization is also localized asymmetrically within such organized molecular assemblies. Electron spin echo detection of laser photogenerated TMB cation in liquid micellar solutions gives a direct measurement of the phase memory magnetic relaxation time which gives additional structural information. The photoionization efficiency has been related to cation-water interactions measured by ESEM. The photoionization efficiency is also dependent on surface charge and is about twofold greater in cationic micelles and vesicles compared to anionic micelles and vesicles. TMB is in a less polar environment in vesicles compared to micelles consistent with ESEM results. The preferential adsorption of metal species at micellar surfaces has been detected by ESEM. Modifications in the micelle surface have been effected by added salts and varying counterions which have been related to cation-water interactions and to the TMB photoionization efficiency. Corresponding changes in the surface and internal micellar structure have been investigated by x-doxylstearic acid spin probes and specifically deuterated surfactants. The decay kinetics of TMB cations in micelles have been interpreted in terms of a time dependent rate constant.

28956 **(DOE/ER/10911—6) Investigation of the structure of photosynthetic reaction centers. Final report, June 1, 1981-May 31, 1984.** van Willigen, H. (Massachusetts Univ., Boston (USA). Dept. of Chemistry). May 1984. Contract AC02-81ER10911. 12p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE84012475.

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A spectroscopic study was made of some water-soluble porphyrins. Dimer formation of tetra(4-sulfonatophenyl)porphyrin and its Zn and Pd complexes has been studied using optical and triplet ESR spectroscopy. The data give information on dimer geometry as well as on dimerization effects on photo-excited triplet properties. It is found that dimerization effects mimic those associated with a transition from in vitro bacteriochlorophyll monomers to primary donor bacteriochlorophyll in reaction centers of photosynthetic bacteria. An ENDOR study was made of the solvation of a porphyrin cation radical. The study established that the ENDOR technique can provide information on weak interactions between paramagnetic macrocycles and surrounding solvent molecules. ENDOR was applied in the study of the photo-excited triplet state of porphyrins and photosynthetic reaction centers randomly oriented in solid solution. Information on the hyperfine interactions between unpaired electrons and nuclear spins obtained with this technique gives an insight into the electronic and geometric structure of these systems.

28957 (DP—1683) Identification of the PuF_6 photoproduct. Young, R.H. (Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Lab.). May 1984. Contract AC09-76SR00001. 25p. NTIS, PC A02/MF A01; GPO Dep. Order Number DE84012150.

PuF_6 has been photolyzed using a broad-band lamp at moderate pressures of 50 to 70 torr in a stainless steel cell, and the resulting solid photoproduct has been collected for identification. Several established analytical techniques have been utilized to characterize this whitish product; results from x-ray diffraction, visible absorption spectroscopy in solution, and wet chemical analysis indicate that the powder is PuF_4. A new analytical approach employing visible absorption spectroscopy of the solid has been developed during this work. These solid state visible spectra of the photoproduct and the reference powder PuF_4 display an excellent correspondence in peak positions and conclusively demonstrate that the photoproduct is a form of finely divided PuF_4.

28958 Non-Foerster fluorescence quenching of trans-etiochlorin I by magnesium octaethylporphyrin in phosphatidylcholine vesicles. Evidence for a statistical pair energy trap. Smalley, J.F. (Brookhaven National Lab., Upton, NY). *Journal of Physical Chemistry;* **87**: No. 14, 2574-2578(1983). Contract AC02-76CH00016.

Fluorescence quenching of trans-etiochlorin I (C) by magnesium octaethylporphyrin (P) has been studied in small (~250 A in diameter) phosphatidylcholine vesicles. It is shown that the quenching is due to the formation of a nonfluorescent statistical pair energy trap between P and C with a critical separation distance between 10 and 18 A. The formation of P^+ as the result of the flash photolysis of C in vesicle suspensions containing both P and C in addition to an electron acceptor demonstrates that excitation of this trap results in an electron transfer from P to C. 31 references, 5 figures.

28959 Primary step in the bacteriorhodopsin photocycle: photochemistry or excitation transfer?. El-Sayed, M.A.; Karvaly, B.; Fukumoto, J.M. (Univ. of California, Los Angeles). *Proceedings of the National Academy of Sciences of the United States of America;* **78**: No. 12, 7512-7516(Dec 1981).

The absorption polarization of the first intermediate (K_{s10}) formed at room temperature in the proton-pumping photochemical cycle of bacteriorhodopsin (bR) shows a strong correlation with the polarization direction of the photolyzed parent molecule. The results suggest that, unlike other photosynthetic systems, excitation transfer does not take place prior to the primary photochemical change in bR. These observations together with the previously observed circular dichroism and the polarization temperature dependence are discussed in terms of the exciton structure and the nature of the absorption bandwidths (i.e., homogeneous vs. inhomogeneous) of the bR monomers within the trimer structure.

28960 Reaction of excited iodine atoms with methyl iodide: rate constant determinations. Haaland, D.M.; Meyer, R.T. (Sandia Lab., Albuquerque, NM). *International Journal of Chemical Kinetics;* **6**: 297-308(1974).

The rate constant for the reaction $I(^2P/sub\ 1/2/) + CH_3I\ \Sigma\ I_2 + CH_3$ has been reevaluated taking into account both collisional deactivation of excited iodine atoms and loss of I_2 by $I_2 + CH_3\ \Sigma\ I + CH_3I$. The reevaluation is based upon data obtained from the flash photolysis of CH_3I using time-resolved mass spectrometry to measure the rate of I_2 formation. Computer simulations of the complete kinetic system and a closed-form solution of a simplified set of the differential equations yielded a value of 6(+/- 4) x 10^8 l./mole-sec for the excited iodine atom reaction in the temperature region of 316 to 447 K. A slight temperature dependence was observed.

4006 Radiation Chemistry

28961 (AD-A—137241/6) Studies of electron-beam-induced decomposition of benzene. Semiannual technical report No. 3. Eckstrom, D.J.; Dickinson, J.S.; Rewick, R.T. (SRI International, Menlo Park, CA (USA)). Dec 1983. 16p. (SRI-MP—83-196). NTIS, PC A02/MF A01.

Experiments have been performed using a Febetron 706 electron beam to study the problems that may occur when benzene is introduced into an electron accelerator. We particularly address the problem of electron-induced fragmentation and polymerization into nonvolatile species that deposit on surfaces, leading to the possibility of surface breakdown in accelerating gaps. Our results show that the amounts of fragmentation and deposition are quite small for a finite number of e-beam pulses, but that problems could arise after extended periods of use. As a conservative design guideline, we estimate that the fragmentation cross section for high energy electrons on benzene is approximately 10 to the minus 16th power sq. cm. and that 10% of these collisions lead to surface deposits.

28962 (CONF-840801—12) Use of pulse radiolysis to measure high temperature kinetics. Jonah, C.D.; Mulac, W.A.; Beno, M.F. (Argonne National Lab., IL (USA)). 1984. Contract W-31-109-ENG-38. 4p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE84011702.

From 20. international symposium on combustion; Ann Arbor, MI, USA (12 Aug 1984).

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Rate constants for OH + CO, OD + CO and OH + CH_4 were measured from room temperature to 1250°K. The dependence of the OH + CO rate on the amount of water vapor in the system were determined at selected temperatures from room temperature to 1230°K.

28963 Nuclear magnetic resonance investigation of fluorinated oxide catalysts. Schlup, J.R.; Vaughan, R.W. (California Inst. of Tech., Pasadena). *Journal of Catalysis;* **85**: No. 2, 311-323(Feb 1984). Contract FG03-76ER10058.

Pulsed nuclear magnetic resonance (NMR) techniques have been used as direct spectroscopic probes of the local chemical environments of the hydroxyl groups and fluorine atoms of fluorinated silica. Hydroxyl groups and fluorine atom concentrations were obtained from NMR data. The line shapes of the hydroxyl group spectra are narrow (<3 kHz) and asymmetric. The fluorine spectra can be described by isolated SiF groups. The anisotropy of the fluorine chemical shift powder pattern is 96 ppM. The hydroxyl groups do not exist as closely spaced pairs. The same is true of the fluorine atoms. Fluctuations occur in the local magnetic fields of the nuclei. The changes that occur in the line shapes of the hydroxyl group and fluorine spectra when observed at various temperatures depend upon the concentration of the surface species and upon the calcining temperature.

28964 Mechanism of the oxidation of dopamine by the hydroxyl radical in aqueous solution. Richter, H.W. (Carnegie-Mellon Univ., Pittsburgh, PA); Waddell, W.H. *Journal of the American Chemical Society;* **105**: No. 16, 5434-5440(10 Aug 1983).

The hydroxyl radical ($HO\rightleftharpoons$) reacts with dopamine (4-(2-aminoethyl)-1,2-benzenediol) via one-electron oxidation producing o-semiquinone and o-semiquinone anion radicals, k = 5.9 x 10^9 M^{-1} s^{-1}. Reaction of HO. with protonated dopamine (H^+QH_3) proceeds via addition to the aromatic ring, while reaction with deprotonated dopamine (H^+QH^-) proceeds via direct, one-electron oxidation. The isomeric hydroxycyclohexadienyl radicals formed via addition of HO. to H^+QH_3 yield three kinetically distinguishable groups (1- and 2-, or 3- and 6-, or 4- and 5-hydroxycyclohexadienyl radicals) with regard to rates of water elimination to produce semiquinone radicals; dehydration is "very fast" (addition of HO. ipso to an OH group), "fast", or "slow". The fast and slow reactions are acid and base catalyzed, with minimal rates at pH 4-5. Acid catalysis appears to be specific, while base catalysis is general. Spectra were determined for the initial products of HO. reaction with H^+QH_3 at pH 3.1 and 4.7. Deprotonation of the HO. adducts is the rate-controlling step in the base-catalyzed water loss at pH ≦ 8.5. For the slow water elimination, rate constants for proton transfer from the adducts to H_3O, HPO_4^{2-}, HO^-, and PO_4^{3-} were 1.7 x 10^2, 6.5 x 10^8, ≦1.5 x 10^{11}, and ≦7.0 x 10^{11} M^{-1} s^{-1}, respectively; for the fast reaction, rate constants for H_2O and HPO_4^{2-} were 1.1 x 10^3 and 2.2 x 10^8 M^{-1} s^{-1}, respectively.

28965 Novel radical anions and hydrogen atom tunneling in the solid state. Williams, F.; Sprague, E.D. (Univ. of Tennessee, Knoxville). *Accounts of Chemical Research;* **15**: 408-415(1982).

The radical anions and radical-anion pairs formed from the γ or X radiation at low temperatures of acetonitrile, methyl halides, and dimethyl sulfoxide are characterized, and the chemical significance of the formation is discussed. ESR measurements of the spin distribution in the products produced by irradiation allow a fairly sharp distinction to be made in the anion form. Dimer radical anions were also found to be formed, but the crystal structure played a part in this process. Some of the radical anions were noted to undergo photolysis to give radical-anion pairs, which revert back to the original form via a thermal process. A competing reaction in which the radical abstracts a hydrogen atom from the neighboring molecule complicates the chemistry of the reversible process.

4007 Radiochemistry And Nuclear Chemistry

REFER ALSO TO CITATION(S) 28041, 28858, 28864, 29803

28966 (CEA-CONF—6922) Thermoelectric properties of M^{4+}/M^{3+} and MO_2^{2+}/MO_2^{+} redox couples of neptunium and plutonium in aqueous $HClO_4$ and HNO_3 media. Blanc, P.; Madic, C. (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France)). Sep 1983. 14p. (CONF-8309124—5). NTIS (US Sales Only), PC A02/MF A01. Order Number DE84750645.

From 1. international conference on the chemistry and technology of the lanthanides and actinides; Venice, Italy (5 Sep 1983).

The thermoelectric properties of redox couple of transuranium elements in acidic, slightly complexing media have been considered. The electromotive force between two inert electrodes in contact with an aqueous solution containing the reversible redox couple and subjected to two different temperature is the product of the temperature gradiant by the thermoelectric power of the redox couple and experimental data are in good agreement with the theoretical calculated value of 0.198 mV/K. The variations of thermoelectric power E versus the ionic strength are very close to theoretical values MO_2^{2+}/MO_2^{+} couples but for M^{4+}/M^{3+} couples a decrease of $HClO_4$ or HNO_3 acid concentrations induces a diminution of E for Pu^{4+}/Pu^{3+} and a maximum for Np^{4+}/Np^{3+}; the origin of the discrepancy is certainly the hydrolysis of the acidic cations: Np^{4+} and Pu^{4+}. No significant differences were found beetween the $HClO_4$ and HNO_3 media.

28967 (CEA-CONF—6964) Evidence and consequences of inner sphere hydrogen bonding between ligands in some mixt complexes of actinide and lanthanide. Livet, J.; Musikas, C. (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France)). Apr 1983. 2p. (CONF-8304147—2). NTIS (US Sales Only), PC A02/MF A01. Order Number DE84750649.

From 13. meeting on actinides; Elat, Israel (26 Apr 1983).

Drastic changes of complexes properties are observed when one hydrogen forming ligand (water, alcohols..) is replaced by an aprotic ligand. In aqueous uranyl (VI) azido complexes there is a red shift of the UV spectra when the last water molecules are replaced by N_3^- to give $UO_2(N_3)_3^-$ and the U-N distance is modified. In europium (III) dialkyldithiophosphate the UV spectra and the metal to sulfur bond are changed by replacement of water by TBP. An important consequence of this phenomena is the solvent extraction. No or small separation of Am (III) from Eu (III) is observed in pure HDEHDTP but addition of TBP leads to high separation coefficients by shortening the Am-S bond.

28968 Reactions with aromatic compounds of recoiling bromine atoms formed from the /sup 76,77/Kr → /sup 76,77/Br transformations. Liquid-phase reactions. Moerlein, S.M. (Washington Univ. School of Medicine, St. Louis, MO); Welch, M.J.; Wolf, A.P. *Journal of the American Chemical Society;* **105**: No. 16, 5418-5428(10 Aug 1983). Contract AC02-77EV04318.

Bromine atoms produced via the $^{76}Kr(EC)^{76}Br$ and $^{77}Kr(\beta^+/EC)^{77}Br$ transformations were reacted with simple benzenoid compounds in the liquid phase. For both ^{76}Kr and ^{77}Kr, bromodeprotonation resulted in a reactivity constant $p^+ \simeq -0.6$, with higher yields for ^{76}Br. Whereas bromodeprotonation was hypothesized to occur via formation of a product-determining σ-complex by radical bromine species, ipso substitution was described in terms of a two-step addition-elimination mechanism in which bond breakage is product determining. While radical bromine species are probably involved in substituent displacements from monosubstituted arenes, polysubstituted aromatic compounds activated to nucleophilic attack were shown to involve an additional nucleophilic reaction pathway.

28969 Reaction selectivity of translationally and electronically excited carbon-11 atoms with ethylene. Ferrieri, R.A. (Brookhaven National Lab., Upton, NY); Wolf, A.P.; Tang, Y.N. *Journal of the American Chemical Society;* **16**: No. 16, 5428-5433(10 Aug 1983). Contract AC02-76CH00016.

Measurement of the ^{11}C distribution in allene-^{11}C provided a means to distinguish the extent to which recoil carbon-11 atoms underwent C-H and C=C insertion pathways into ethylene. Combined moderator and scavenger studies also provided a means to alter the translational energy and electron spin distributions of the carbon-11 atoms. Results from these studies indicated that at the upper end of the energy range where carbon atoms become chemically reactive, C=C insertion occurred preferentially over C-H insertion for both $C(^3P)$ and $C(^1D)$ atoms. At the low end of the energy range, $C(^3P)$ carbon atoms reacted preferentially via C-H insertion. On the other hand, $C(^1D)$ atoms were not reactive toward C-H insertion, at least in the formation of allene-^{11}C.

4008 Combustion, Pyrolysis, And High-temperature Chemistry

REFER ALSO TO CITATION(S) 28878

28970 (AD-A—137079/0) Ionic mechanisms of carbon formation in flames. Annual report 1 Apr 81-31 Mar 82. Calcote, H.F.; Olson, D.B. (Aerochem Research Labs., Inc., Princeton, NJ (USA)). Jan 1983. 58p. NTIS MF A01.

The chemi-ion ion-molecule mechanism of soot formation has gained further support by detailed studies of ion profiles through sooting flames. Langmuir probes have been used to obtain absolute ion concentrations in premixed acetylene-oxygen flames over a range of equivalence ratios extending from nonsooting to sooting flames. These data have been used in a preliminary calibration of the mass spectrometer. The effect of initial temperature on the tendency of several flames to soot has been measured. For a given premixed flame the tendency to soot decreases with increasing temperature but for a series of fuels with increasing tendency to soot, the temperature at which soot occurs increases with the tendency to soot. Ion concentrations will be measured in this set of flames. Calculations of particle electronics and coagulation rates have been initiated to determine whether the large molecular ions observed in sooting flames are the cause or effect of soot formation and in preparation for quantitative modeling of soot formation.

28971 (AD-A—137927/0) Properties of three dimensional energetic solids and molecular crystals. Annual technical report No. 3, 1 Jul-31 Dec 83. Kunz, A.B. (Michigan Technological Univ., Houghton (USA)). 1 Feb 1984. 8p. NTIS, PC A02/MF A01.

The effect of exciton formation upon combustion of solid fuels is examined by applying ab initio theory to solid and gas phase nitric oxide and its dimer.

28972 (DOE/ER/10819—T1) Spectroscopy and structures of reactive intermediates in flames with far-infrared lasers. Final report. Saykally, R.J. (California Univ., Berkeley (USA). Dept. of Chemistry). 31 Dec 1982. Contract AT03-81ER10819. 4p. NTIS, PC A02/MF A01. Order Number DE83008111.

During the two years duration of this project we have completed construction of a new type of apparatus - a molecular beam laser electric resonance spectrometer, carried out preliminary ex-

periments on the reactive intermediates HCOH, HCCN, CH_3, and C_3, and extensively modified our existing laser magnetic resonance spectrometer to accommodate studies of flames on a large and general scale.

28973 (LBL—17666) Density fluctuations in premixed turbulent flames. Namazian, M.; Talbot, L.; Robben, F. (Lawrence Berkeley Lab., CA (USA); California Univ., Berkeley (USA). Dept. of Mechanical Engineering). Mar 1984. Contract AC03-76SF00098. 21p. (CONF-840801—13). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE84012055.

From 20. international symposium on combustion; Ann Arbor, MI, USA (12 Aug 1984).

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The simultaneous two-point density fluctuations in a V-shaped turbulent flame are measured using a two-point Rayleigh scattering method. A wrinkle laminar flame model with finite instantaneous flame thickness is developed for the flames studied. The reaction front probability density function (pdf) is both measured directly and also calculated from the measured mean density. An analytical expression for this pdf is given which is derived based on a thin flame model. The mean, rms and correlation coefficients are calculated using the finite reaction front thickness model and the results are compared with the experimental data. The pdf of the intermediate states are shown to be due to the reaction front thickness.

28974 (SAND—84-8220) Stretch effects in plane premixed hydrogen-air flames. Warnatz, J.; Peters, N. (Sandia National Labs., Livermore, CA (USA); Heidelberg Univ. (Germany, F.R.). Physikalisch-Chemisches Inst.; Technische Hochschule Aachen (Germany, F.R.). Inst. fuer Allgemeine Mechanik). Apr 1984. Contract AC04-76DR00789. 27p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE84012035.

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A numerical analysis is performed of a plane premixed flame with detailed kinetics which is stretched by a diverging flow field. The numerical results are compared to the analytic result obtained from large activation energy asymptotics for one-step kinetics. A rich flame with a hydrogen mole fraction in the unburnt of X/sub H_2/ = 0.6 and a lean flame with X/sub H_2/ = 0.15 are considered. As predicted by the asymptotic theory, the mass flow rate through the flame is decreased due to stretch for the rich flame, while it is increased for the lean flame. Extinction occurs due to flame stretch for the rich and due to flame compression for the lean flame.

42 ENGINEERING

4201 General Engineering

REFER ALSO TO CITATION(S) 30083

28975 (PB—84-156223) Ground-coupled heat pump demonstration. O'Connell, T. (Spencertown Geo-Solar Associates, NY (USA)). Sep 1983. 72p. NTIS, PC A04/MF A01.

This report presents the results of a field evaluation of an innovative ground-coupled heat pump system which features a unique collector design and system control strategy aimed at maximizing heat pump performance by minimizing ground temperature change. The collector design includes several short closed loops, each consisting of a pair of polyethylene pipes buried 12 to 18 inches apart in a horizontal trench approximately six feet below ground. A micropressor is used to control flow and optimize system operation. Extrapolation of the results of experiments conducted on a unit length (250 ft.) of collector field during the 1981-82 and 1982-83 heating seasons indicates that a system seasonal performance factor of 2.75 to 3.0 will be achievable in practice.

4202 Facilities And Equipment

REFER ALSO TO CITATION(S) 27752, 27753, 27824, 27903, 27904, 27906, 28031, 28264, 28532, 29097, 29099, 29885, 29997, 30028, 30045

28976 (AD-A—136720/0) Study of sleeping in a chemical protective ensemble in a warfare environment. Final report 26 Aug 81-2 Dec 82. Cacioppo, G.M.; Annis, J.F. (Macaulay-Brown, Inc., Fairborn, OH (USA)). Dec 1982. 77p. NTIS, PC A05/MF A01.

Experiments were performed to evaluate the quality of sleep experienced by individuals wearing different chemical protective ensembles (CPE). A series of seven experiments were conducted in which two test subjects slept overnight in an environmentally controlled room while wearing either pajamas (control ensemble) or one of three different CPEs. The three CPEs tested were: the standard West German ground crew ensemble, an ensemble comprised of a combination of equipment of which the Canadian chemical protective coverall was the principal item of clothing, and the U.S. Army standard ground crew ensemble Body temperatures, sleep records, and other physiological measurements were monitored overnight and form the basis of the objective evaluation. Subjective data were collected by an experiment monitor who kept the test participants under constant observation. Additionally, the participants were required to complete a standard debriefing questionnaire form each post-experiment morning. Because of the limited scope of the experiment, statistical analysis was not appropriate. However, both the objective and subjective data reflected consistent trends and allow confidence in the assessment that current U.S. and NATO CPE combinations provide for adequate sleep quality.

28977 (AD-A—136722/6) Thin film technology of high-critical-temperature superconducting electronics. Annual report 1 Aug 82-30 Oct 83. Talvacchio, J.; Braginski, A.I.; Gavaler, J.R.; Janocko, M.A.; Manocha, A.S. (Westinghouse Electric Corp., Pittsburgh, PA (USA). Research and Development Center). 5 Dec 1983. 74p. NTIS, PC A04/MF A01.

The objective of the first year's work was to investigate A15 superconductor/barrier oxide interfaces, identify oxide depth profiles, and determine resulting tunneling characteristics using soft tunnel junction counterelectrodes. Bilayers consisting of Nb and vanadium-silicon (A15) base electrodes and thin Y, Al, and Si barriers have been deposited in-situ and oxidized in humid air for up to three days. XPS analysis was used to compare the barrier coverage, uniformity, oxidation, and ability to protect the base electrode from oxidation for three deposition techniques: dc magnetron sputtering, dc diode sputtering, and reactive diode sputtering followed by pyrolysis. Y and Al have been found to be fully oxidized due to long oxidation times. In the above conditions the overlayers did not protect the superconductors from oxidation/hydration, and the surface of oxidized vanadium-silicon was also degraded by atomic segregation. The tunneling I-V characteristics exhibited very high leakage currents also suggestive of incomplete superconductor coverage by the metallic overlayer. Mo-Re was investigated for its potential as a high-critical-temperature counterelectrode. A very low oxidation rate was found indicating potential compatibility with yttrium hydroxide-sealed barriers. Low temperature growth (60 C) of MoRe (86 at. % Mo) with only a 5% decline in critical temperature has been demonstrated. Work will continue in a closed system to eliminate the base superconductor degradation, reduce leakage and study high-critical-temperature counterelectrodes.

28978 (AD-A—137130/1) Development of a pressurized anti-exposure barrier system. Interim report, October 1981-May 1983. Lewyckyj, J.Z. (Naval Air Development Center, Warminster, PA (USA). Aircraft and Crew Systems Technology Directorate). 1 May 1983. 77p. (NADC—83055-60). NTIS, PC A05/MF A01.

A protective foam barrier was conceived to serve as a normal flight garment to enhance flame resistance, reduce adverse thermal conduction, and provide flotation during emergency conditions. Preliminary studies investigated feasibility of utilizing pressurized foam between two layers of cloth to envelop the wearer's torso and limbs.

28979 **(AD-A—137288/7) Standards for protective goggles for use in the cold. Final report.** Luria, S.M. (Naval Submarine Medical Center, Groton, CT (USA). Submarine Medical Research Lab.). 21 Dec 1983. 12p. (NSMRL—1014). NTIS, PC A02/MF A01.

The characteristics of goggles needed to protect the eyes in cold environments are specified, based on laboratory investigations, field studies, and a survey of the literature. The transmittance of the filters, the magnitude of distortion, the degree of chromaticity, resistance to fogging, and the physical standards of the filters are considered.

28980 **(AD-A—137315/8) Missile component repair while wearing nbc protective clothing. Final report.** Waugh, J.D.; Kilduff, P.W. (Army Human Engineering Labs., Aberdeen Proving Ground, MD (USA)). Jan 1984. 50p. NTIS, PC A03/MF A01.

The US Army Human Engineering Laboratory assessed possible degradation in the performance of missile repair persons while wearing NBC protective clothing. Nine male soldiers, just graduated from the Advanced Individual Training Course in Missile Repair, were required to perform repair tasks in three replications. Two repair tasks were chosen; one considered non-difficult whose activities concentrated on procedural diagnostics and fault isolation; the second considered difficult, required manipulating small machine parts and hand tools requiring fine eye-hand coordination. The experimental results and subsequent comparative statistical analysis showed no degradation in performance of the easier procedures and diagnostic task. The time to complete the more difficult task was degraded (increased) on the average of 45% in MOPP 4 with a definite contribution to degradation attributed to the mask/hood and the protective gloves by themselves. A significant improvement attributed to learning from the first to the second presentation was found, but not from the second to the third presentation. The participants' degree of learning was neither enhanced nor held back while in protective clothing as compared to working in the duty uniform.

28981 **(BNL-NUREG—34542) Seismic models for buried tanks.** Philippacopoulos, A.J.; Costantino, C.J.; Miller, C.A. (Brookhaven National Lab., Upton, NY (USA)). 17 Jun 1984. Contract AC02-76CH00016. 9p. (CONF-840647—16). NTIS, PC A02/MF A01; 1 - GPO; GPO Dep. Order Number DE84010886.

From ASME pressure vessel and piping conference; San Antonio, TX, USA (17 Jun 1984).

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Numerical models to treat the problem of evaluating the seismic response of partially filled buried flexible tanks are presented. Approximate sloshing and finite element models are used to estimate the response of the fluid. Transfer functions associated with the soil/tank/fluid system obtained by alternate methods are presented. Finally, the effects of fluid discretization on the seismic stresses of the tank are examined.

28982 **(CEA-CONF—6814) Gamma ray benchmark on the spent fuel shipping cask TN 12.** Blum, P.; Cagnon, R.; Cladel, C.; Ermont, G.; Nimal, J.C. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France)). May 1983. 8p. (CONF-830538—27). NTIS (US Sales Only), PC A02/MF A01. Order Number DE84750677.

From 6. international conference on radiation shielding; Tokyo, Japan (16 May 1983).

The purpose of this benchmark is to compare measurements and calculation of gamma-ray dose rates around a shipping cask loaded with 12 spent fuel elements of FESSENHEIM PWR type. The benchmark provides a means to verify gamma-ray sources and gamma-ray transport calculation methods in shipping cask configurations. The comparison between measurements and calculations shows a good agreement except near the fuel element top where the discrepancy reaches a factor 2.

28983 **(CONF-840413—9) Basic research on intelligent robotic systems operating in hostile environments: new developments at ORNL.** Barhen, J.; Babcock, S.M.; Hamel, W.R.; Oblow, E.M.; Saridis, G.N.; de Saussure, G.; Solomon, A.D.; Weisbin, C.R.;. (Oak Ridge National Lab., TN (USA)). Apr 1984. Contract AC05-84OR21400. 24p. NTIS, PC A02/MF A01; GPO Dep. Order Number DE84011464.

From Topical meeting on robotics and remote handling in hostile environments; Gatlinburg, TN, USA (23 Apr 1984).

Robotics and Artificial Intelligence research carried out within the Center for Engineering Systems Advanced Research (CESAR) is presented. Activities focus on the development and demonstration of a comprehensive metholological framework for intelligent machines operating in unstructured hostile environments. Areas currently being addressed include mathematical modeling of robot dynamics, real-time control, world modeling, machine perception and strategy planning.

28984 **(CONF-8404141—2) Frequency spectrum of an elastic Sierpinski gasket.** Liu, S.H. (Oak Ridge National Lab., TN (USA)). Mar 1984. Contract AC05-84OR21400. 5p. NTIS, PC A02; 3; GPO Dep. Order Number DE84011445.

From International topical conference on kinetics of aggregation and gelation; Atlanta, GA, USA (2 Apr 1984).

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The frequency spectrum of an elastic fractal system has been studied by solving a mass and spring problem on a Sierpinski gasket. A mass M is attached at every node and a spring constant K is assumed for every link. The vibrational modes are given by the zeros of a 6x6 dynamical matrix. It is shown that the density of low energy modes obeys a power law, N(omega) = omega/sup d-1/, where the spectral density d = 2 anti d/(1+d) and d is the fractal dimension. It is also argued that this relation between d and anti d is universal to all elastic fractal solids.

28985 **(DP-MS—84-39) Applicon/IBM interface for drawing management and plotting.** Flanders, K.L. Jr. (Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Lab.). 1984. Contract AC09-76SR00001. 16p. (CONF-8405151—1). NTIS, PC A02/MF A01; GPO Dep. Order Number DE84011519.

From Computer aided engineering symposium; Wilmington, DE, USA (15 May 1984).

The presentation, Applicon/IBM Interface, describes the functions made available to the Computer-Aided Drafting (CAD) group by providing a method of transferring machine readable copies of drawings from CAD's Applicon system to the IBM based Central Computer Facility (CCF). The Calcomp 925 format is used as the format when transferring drawings between the two systems. The development of a simulator which runs on the IBM host system is complete. This simulator decodes and interprets the Calcomp 925 instructions and produces commands to drive the IBM host attached Versatec 42″ plotter, thus providing the ability for CAD-generated drawings to be plotted on the host attached plotter.

28986 **(SAND—83-0319) Evaluation of computer programs used for structural analyses of impact response of spent fuel shipping casks.** Lewis, B.A.; Gwinn, K.W. (Sandia National Labs., Albuquerque, NM (USA)). May 1984. Contract AC04-76DP00789. 61p. NTIS, PC A04/MF A01; GPO Dep. Order Number DE84012887.

This report presents the results of a study of impact analyses of a generic spent-fuel cask. The study compares the use and results of three different finite element computer codes. Seven different cask-like model analyses are considered. The models encompass both linear and nonlinear geometric and material behavior. On the basis of the analyses results, this report recommends what parameters are useful in the comparison of different structural finite element computer programs. 5 references, 36 figures, 11 tables.

28987 **(SAND—84-0139) Test specifications for nondestructive evaluation of foam anomalies in wall sections of TRUPACT-I.** Uncapher, W.L.; Diggs, J.M. (Sandia National Labs., Albuquerque, NM (USA)). May 1984. Contract AC04-76DP00789. 28p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE84012617.

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This report describes the method used to identify voids or poor quality of in-situ foam in a transport packaging. This procedure was developed for use on the TRUPACT, a transporter for contact-handled transuranic wastes, which incorporates polyurethane foam as impact and thermal protection. The evaluation procedure is specific to the TRUPACT but may be applicable to other packagings where foam is poured into place as constituents, reacts and rises to fill its intended space. Instrumentation, time requirements and test sensitivities are detailed in this procedure.

28988 **(SAND—84-0228) Cornering water jet drill for creating horizontal holes in coal seams.** Shirey, D.L.; Engler, B.P. (Sandia National Labs., Albuquerque, NM (USA)). May 1984. Contract AC04-76DP00789. 69p. NTIS, PC A04/MF A01; 1; GPO Dep. Order Number DE84012895.

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Sandia National Laboratories has developed a drilling system which uses high velocity water jets to make horizontal holes in coal seams accessed through vertical boreholes. For underground coal gasification (UCG), these horizontal holes can be drilled to create linking paths between vertical or horizontal process wells. Three test series have been conducted to study and improve the drilling system and, ultimately, to prove the viability of the concept. With the exception of a persistent string binding problem, which ultimately determined the hole depth, all drill system components either performed as designed or exhibited weaknesses which could be remedied with minor alterations. The cornering water jet drill (CWJD) concept was proven to be viable for drilling horizontal holes in coal seams. For distances greater than 50 ft (15.2 m), however, making the process a routine operation will require additional study and improvement. 12 references, 16 figures.

28989 **Shock wave absorber having apertured plate.** Shin, Y.W.; Wiedermann, A.H.; Ockert, C.E. (to Dept. of Energy). US Patent Application 6-526,765. 26 Aug 1983. 22p. Contract W-31-109-ENG-38.

The shock or energy absorber disclosed herein utilizes an apertured plate maintained under the normal level of liquid flowing in a piping system and disposed between the normal liquid flow path and a cavity pressurized with a compressible gas. The degree of openness (or porosity) of the plate is between 0.01 and 0.60. The energy level of a shock wave travelling down the piping system thus is dissipated by some of the liquid being jetted through the apertured plate toward the cavity. The cavity is large compared to the quantity of liquid jetted through the apertured plate, so there is little change in its volume. The porosity of the apertured plate influences the percentage of energy absorbed.

28990 **Dual rotating shaft seal apparatus.** Griggs, J.E.; Newman, H.J. (to Dept. of Energy). US Patent Application 6-505,011. 16 Jun 1983. 16p. Contract W-7405-ENG-36.

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The report is directed to apparatus suitable for transferring torque and rotary motion through a wall in a manner which is essentially gas impermeable. The apparatus can be used for pressurizing, agitating, and mixing fluids and features two ferrofluidic, i.e., ferrometic seals. Each seal is disposed on one of two supported shafts and each shaft is operably connected at one end to a gear mechanism and at its other end to an adjustable coupling means which is to be connected to a rotatable shaft extending through a wall through which torque and rotary motion are to be transferred.

28991 **Method for making generally cylindrical underground openings.** Routh, J.W. (to Dept. of Energy). US Patent Application 6-498,435. 26 May 1983. 21p. Contract W-7405-ENG-48.

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A rapid, economical and safe method for making a generally cylindrical underground opening such as a shaft or a tunnel is described. A borehole is formed along the approximate center line of where it is desired to make the underground opening. The borehole is loaded with an explodable material and the explodable material is detonated. An enlarged cavity is formed by the explosive action of the detonated explodable material forcing outward and compacting the original walls of the borehole. The enlarged cavity may be increased in size by loading it with a second explodable material, and detonating the second explodable material. The process may be repeated as required until the desired underground opening is made. The explodable material used in the method may be free-flowing, and it may be contained in a pipe.

28992 **Manipulator having thermally conductive rotary joint for transferring heat from a test specimen.** Haney, S.J.; Stulen, R.H.; Toly, N.F. (to Dept. of Energy). US Patent Application 6-491,134. 3 May 1983. 18p. Contract AC04-76DP00789.

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A manipulator for rotatably moving a test specimen in an ultra-high vacuum chamber includes a translational unit movable in three mutually perpendicular directions. A manipulator frame is rigidly secured to the translational unit for rotatably supporting a rotary shaft. A first copper disc is rigidly secured to an end of the rotary shaft for rotary movement within the vacuum chamber. A second copper disc is supported upon the first disc. The second disc receives a cryogenic cold head and does not rotate with the first disc. The second disc receives a cryogenic cold head and does not rotate with the first disc. A sapphire plate is interposed between the first and second discs to prevent galling of the copper material while maintaining high thermal conductivity between the first and second discs. A spring is disposed on the shaft to urge the second disc toward the first disc and compressingly engage the interposed sapphire plate. A specimen mount is secured to the first disc for rotation within the vacuum chamber. The specimen maintains high thermal conductivity with the second disc receiving the cryogenic transfer line.

4203 Lasers

28993 **(AD—909773/4) Studies in optics. Technical report 13 Feb 70-15 Dec 72.** Thompson, B.J.; Hercher, M.; Forsyth, J.M.; Sinclair, D.C.; Balasubramanian, N. (Rochester Univ., NY (USA). Inst. of Optics). Apr 1973. 152p. NTIS, PC A08/MF A01.

These studies in optics relate to a variety of interconnected problems in the evaluation and controlled improvement of the output characteristics of lasers and the design of laser systems. Four major areas of endeavor are focussed upon in the sections of this report. Section II is a study of techniques for assessing laser beam propagation characteristics for both cw and pulsed lasers using holography in conjunction with interferometry. Section III concerns itself with some design problems of efficient solid state laser systems with high average power and low beam divergence with particular reference to the measurement and correction of optical distortion in solid laser rods. Section IV has as its objective a means of producing high-speed continuously scanning laser beams by use of intra-cavity beam deflection. The final portion is an evaluation of the technique of ac interferometry.

28994 **(AD—921095/6) Development of a solid fueled scrubber ejector for an hf/df chemical laser. Final report Apr-Oct 73.** Laeger, H.O.; Cavalleri, R.J. (Atlantic Research Corp., Alexandria, VA (USA)). Jun 1974. 72p. NTIS, PC A04/MF A01.

The goal of this research was the determination of whether or not the solid fueled ejector/scrubber concepts presented, could be developed into a practical system whose performance is competitive with already existing systems while offering all the weight, volume, and reliability advantages inherent to solid fueled devices, and if such a system is attractive to indicate those areas toward which further research should be directed. To accomplish this goal, a simultaneous two-fold feasibility demonstration of the ejector/scrubber was undertaken; (1) to demonstrate the feasibility of using

solid propellants to produce the gases necessary to drive an ejector which could eventually be attached to the optical cavity of an HF or DF chemical laser, (2) to demonstrate that the gases produced from the solid propellant combustion could chemically react with the toxic HF and/or DF chemical laser effluents to aid in their detoxification. To accomplish these tasks, an ejector gas dynamic analysis was performed along with a kinetic and thermodynamic analysis of possible decontamination reactions. Based upon results from these analyses, ejector hardware was constructed and propellants formulated with which to experimentally test the concepts.

28995 **(AD-A—136906/5) Transverse and quantum effects in light control by light; (a) parallel beams: pump dynamics for three level superfluorescence; and (b) counterflow beams: an algorithm for transverse, full transient effects in optical bi-stability in a fabryperot cavity. Final report Dec 79-31 Jul 83.** Mattar, F.P. (Polytechnic Inst. of New York, Brooklyn (USA). Dept. of Mechanical and Aerospace Engineering). 1983. 480p. NTIS, PC A21/MF A01.

Computational methodologies were developed to treat rigorously (1) transverse boundary in an inverted (amplifying) media; (2) to treat quantum fluctuations in an initial boundary condition in the light-matter interactions problem; (3) construct a two-laser three-level code to study light control by light effect; (4) construction of a data base that (a) would manage the production of different types of laser calcualtions: cylindrical, cylindrical with atomic frequency broadening, cartesian geometry; (all of the above with quantum mechanical initiation), (b) allow parametric comparison within the same type of calculations, by establishing a unifying protocol of software storage, of the various refinements of the model could be contrasted among themselves and with experiment; (5) construct an algorithm for counterbeam transient studies for optical bistability and optical oscillator studies. (A) Transverse propagation effects in an inverted medium were studied. Special care had to be taken to treat the boundary reflection conditions. If ill-posed, they can obscure the emergence of any new physical results. The two transverse effects considered are (1) the 'spatial averaging' associated with the inial atomic inversion density being radially dependent (since the pump which inverts the sample has typically a Gaussian-like profile); and (2) the 'diffraction coupling' (which permits the various parts of the cylindrical cross-section to communicate, interact and emit at the same time). The first effect is important for large Fresnel numbers, whereas the second predominant for small Fresnel numbers.

28996 **(AD-P—002444/8) Application of metal hydrides for gas handling in hydrogen masers.** Wang, H.T.M. (Hughes Research Labs., Malibu, CA (USA)). 1983. 5p. NTIS, PC A02/MF A01.

Reversible interaction of hydrogen with certain metals and alloys have been employed to effectively satisfy the hydrogen supply and flow regulation, as well as vacuum maintenance requirements of a hydrogen maser. In addition to providing a significant reductions in maser size, weight and power consumption, the hydride components also lead to improved system reliability. A hydrogen supply for seven years of operation of an oscillating compact maser can be stored in 50 grams of LaNi5 or LaNi4.7A10.3. The source occupies a volume of less than 50 cc, including an electrically controlled palladium-silver alloy flow regulator. A combination getter-ion vacuum pump system for the maser was developed using a zirconium graphite getter. Operational experience indicates that for reliable maser operation, a clean, bakeable vacuum system design is a critical requirement.

28997 **(AD-P—002451/3) Performance of compact hydrogen masers.** Kirk, A. (Jet Propulsion Lab., Pasadena, CA (USA)). 1983. 7p. NTIS, PC A02/MF A01.

Compact hydrogen masers have been built and are under continuing development at several organizations. JPL maintains a special facility which is dedicated to testing, evaluating, improving and maintaining state of the art frequency standards. This paper presents the results of a series of tests that were performed at this facility on two different types of compact hydrogen masers. One of these masers is a prototype unit developed by Hughes Research Laboratories, Malibu, CA for the United States Naval Research Laboratory. This maser uses O-enhancement to achieve cavity oscillation and is equipped with a cavity tuning servo system. The other is a prototype passive hydrogen maser also equipped with a cavity tuning servo system. The other is a prototype passive hydrogen maser also equipped with a cavity tuning servo system and was developed by the National Bureau of Standards, Boulder, CO. The data presented includes output frequency versus certain environmental parameters, Allan variance and drift. The work on the Hughes Research maser was sponsored by the United States Naval Research Laboratory (NRL). The NBS passive maser development was sponsored by the National Aeronautics and Space Administration (NASA) and NRL.

28998 **(AD-P—002452/1) Cold hydrogen maser research at SAO (Smithsonian Astrophysical Observatory) and related developments.** Vessot, R.F.C.; Mattison, E.M.; Imbier, E. (Smithsonian Astrophysical Observatory, Cambridge, MA (USA)). 1983. 6p. NTIS, PC A02/MF A01.

The cryogenically-cooled maser provides a means for measuring frequency shifts and relaxation properties of storage wall coating materials that can be frozen in place from substances normally in the gaseous phase. We report initial measurements for FEP-120 Teflon between 77K and 48K and compare them with the 372K to 77K data of de Saintfuscien. Some of the design features of the maser are described. The cryomaser's hydrogen dissociator is located entirely within the vacuum enclosure and operates at 77K. The in-vacuum dissociator and other developments that have been adapted and tested in a room temperature maser, and that are applicable for both space and terrestrial use, are also discussed.

28999 **(CONF-840449—6) Theory of four-wave mixing for vuv generation.** Payne, M.G.; Garrett, W.R.; Ferrell, W.R. (Oak Ridge National Lab., TN (USA)). Apr 1984. Contract AC05-84OR21400. 11p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE84011663.

From 2. symposium on resonance ionization spectroscopy and its applications; Knoxville, TN, USA (16 Apr 1984).

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The discussion presented emphasizes the development and understanding of the physical phenomenon involved in four-wave mixing or third-harmonic generation in gas phase media. The system considered involves unfocused, plane-polarized light from two lasers passing through a gas cell containing an active gas and a buffer gas. (LEW)

29000 **(DFVLR-FB—83-21) Microwave discharge in a supersonic flow for the excitation of a gasdynamic CO-laser.** Hoffmann, P. (Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt e.V., Stuttgart (Germany, F.R.). Inst. fuer Technische Physik). 1983. 127p. (In German). NTIS (US Sales Only), PC A07/MF A01. Order Number DE84751223.

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The specific problems of such distinct fields of technical science and engineering, as the plasmaphysics of rf-discharges, the gasdynamics of supersonic flows, and the CO-laser kinetics, are discussed in order to combine them to an adequate description of a microwave-excited gasdynamic CO-laser. This laser is distinguished by a new method of coupling microwave energy to a discharge located within a supersonic flow. Its constructional design and principle of operation are shown in detail. The satisfactory agreement between the experimental results and the predictions of a theoretical model shows that the basic laser processes are correctly described.

29001 (INIS-mf—8921, pp 50) **Nonlinear effects in wiggler free-electron-lasers.** Friedland, L.; Fruchtman, A. (Hebrew Univ., Jerusalem (Israel). Racah Inst. of Physics). 1983. NTIS (US Sales Only), PC A05/MF A01. Order Number DE84780235. (CONF-8303128—Summ.). TI84780235

From Israel Physical Society annual meeting; Ramat-Gan, Israel (24 Mar 1983).

29002 (INIS-mf—8921, pp 48) **Design and operation of a CO_2 waveguide laser.** Naftaly, M.; Oppenheim, U.P.; Koren, G. (Technion-Israel Inst. of Tech., Haifa. Dept. of Physics). 1983. NTIS (US Sales Only), PC A05/MF A01. Order Number DE84780235. (CONF-8303128—Summ.). TI84780235

From Israel Physical Society annual meeting; Ramat-Gan, Israel (24 Mar 1983).

29003 (INIS-mf—8921, pp 51) **Distributed feedback dye laser in conjunction with a Haensch type dye laser.** Golub, I.; Erez, G.; Shuker, R. (Ben-Gurion Univ. of the Negev, Beersheba (Israel). Dept. of Physics). 1983. NTIS (US Sales Only), PC A05/MF A01. Order Number DE84780235. (CONF-8303128—Summ.). TI84780235

From Israel Physical Society annual meeting; Ramat-Gan, Israel (24 Mar 1983).

29004 **(PNL-SA—12218) Optical coating materials for the ultraviolet - selection and characterization.** Pawlewicz, W.T. (Pacific Northwest Lab., Richland, WA (USA)). Apr 1984. Contract AC06-76RL01830. 6p. (CONF-8405158—1). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE84011504.

From SPIE technical symposium; Arlington, VA, USA (1 May 1984).

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Experiences at Pacific Northwest Laboratory in the selection, deposition and characterization of oxide optical coatings for use with excimer lasers are reviewed. Fabrication results for all-dielectric high reflectors at 248 and 308 nm are presented. Glassy or amorphous coating materials such as SiO_2 and Ta_2O_5 appear to be more promising for ultraviolet use than polycrystalline materials such as Y_2O_3, Al_2O_3, ZrO_2 and HfO_2 because of reduced surface roughness. Glassy materials, formed by ion bombardment or by mixing oxides according to the method of Sanders, Farabaugh and Haller, appear to be a promising direction for future ultraviolet coating development.

29005 **(UCID—20085) Modal parameter estimation via shaker vs speaker excitation.** Weaver, H.J.; Burdick, R.B. (Lawrence Livermore National Lab., CA (USA)). May 1984. Contract W-7405-ENG-48. 14p. NTIS, PC A02/MF A01; GPO Dep. Order Number DE84012897.

When dynamically testing delicate laser components (e.g. an elliptical glass laser disc) it is often impossible to provide a direct contact excitation source such as an impact hammer or shaker. This is because of the delicate and/or brittle nature of the material from which the components are constructed. The alternate approach that is often used in a test of this type is to excite the component with an acoustic speaker. In this paper we describe a small series of tests in which we compare the modal parameters obtained by using a speaker as an excitation source with those obtained on the same object when the excitation was provided by a shaker.

29006 **Room-temperature cw operation of InGaAsP/InGaP lasers at 727 nm grown on GaAs substrates by liquid phase epitaxy.** Wakao, K.; Nishi, H.; Kusunoki, T.; Isozumi, S.; Ohsaka, S. (Fujitsu Laboratories, Ltd., 1677 Ono, Atsugi, 243-01, Japan). *Applied Physics Letters;* **44**: No. 11, 1035-1037(1 Jun 1984).

InGaAsP/InGaP lasers emitting at 724—727 nm have been fabricated on GaAs substrates using liquid phase epitaxy. The threshold current is reduced to 8 kA/cm² by thinning the active layer. Room-temperature cw operation is achieved for the first time in the lasing wavelength range below 760 nm in this quaternary system.

29007 **KrF laser kinetics studies.** Mandl, A.; Klimek, D.; Parks, J.H. (Avco Everett Research Laboratory, Incorporated, Everett, Massachusetts 02149). *Journal of Applied Physics;* **55**: No. 11, 3940-3949(1 Jun 1984). Contract AC08-80DP40130.

A series of measurements characterizing an e beam pumped KrF* laser was carried out using a 200-nsec e-beam pulse having a rise time of 25 nsec at current densities up to 50 A/cm². These pump conditions are relevent for inertial confinement fusion laser drivers. The measurements include fluorescence efficiency, sidelight suppression of the fluorescence during lasing, and laser energy output over a wide range of laser parameters including: total density 0.5—2.0 amagats, temperature 300—400 K, fluorine density 0.15%—0.5%, current density 38—50 A/cm² and various mirror transmissions. This data was used to verify and refine a model of KrF* kinetics which was then used to estimate the performance of an angular multiplexed power amplifier suitable for laser fusion applications.

29008 **Solvent effects in oscillator/amplifier configured dye lasers.** Chen, C.H.; Kramer, S.D. (Oak Ridge, National Laboratory, Chemical Physics Section, P.O. Box X, Oak Ridge, Tennessee 37830). *Applied Optics;* **23**: No. 4, 526-527(15 Feb 1984). Contract W-7405-ENG-26.

To optimize the output of dye lasers excited by high-powered pump lasers, it seems to be implicit that the dye: solvent combination that produces the maximum output for the oscillator is also the optimum for use in the amplifier. This paper reports an example whereby the optimized output of the oscillator/amplifier dye laser was obtained through the use of two different solvents: DCM and DMSO.

29009 **(UCRL-Trans—11964) Light-induced quenching of the spontaneous and stimulated emission of dye solutions.** Rudik, K.I.; Pikulik, L.G.; Senkevich, L.P.; Maksimov, A.I. Translated from *Acta Physica et Chemica ;* No. 23, 165(1977). Contract W-7405-ENG-48. 11p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE84010298. DE84010298

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Temperature-dependence of light-induced quenching of spontaneous and simulated emission was investigated. Changes in the degree of polarization were studied during quenching. The role played by the difference between quenching and lasing wavelength was explained.

4204 Heat Transfer And Fluid Flow

29010 **(CEA-CONF—6920) Some applications of mixed finite elements to an ultra compressible or a two phase flow computations.** Forestier, A.; Montagne, J.L. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France)). Sep 1983. 8p. (CONF-830972—2). NTIS (US Sales Only), PC A02/MF A01. Order Number DE84750634.

From 20. congress of the International Association of Hydraulic Research; Moscow, USSR (5 Sep 1983).

An homogeneous model solving two phase flow equations leads to study Euler equations as for compressible flow. An application of mixed element method built for Navier-Stokes equations is presented with a semi-implicit scheme (2D and 3D case). Some theoretical results about stability and approximation have been obtained and numerical tests have been performed and have given satisfactory results: the first one is a computation in a steam generator and the second one about a nozzle study.

29011 **(CEA-CONF—6921) Many-dimensional calculation of heat transfer and viscous fluid flow with the numerical Control Variables Method.** Le Coq, G.; Boudsocq, G.; Raymond, P. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France)). Sep 1983. 9p. (In French). (CONF-830972—3). NTIS (US Sales Only), PC A02/MF A01. Order Number DE84750635.

From 20. congress of the International Association of Hydraulic Research; Moscow, USSR (5 Sep 1983).

This paper deals with a fully implicit method for calculation of multidimensional viscous, heat conducting and compressible fluid flow problems. First the numerical Control Variables Method which solves conservation laws for a fluid flow is detailed. Then some results obtained for two dimensional flow in cavities are presented.

29012 **(CTOM—50802) Transient two phase flows. Refilling and rewetting of a hot horizontal tube.** Chan, A.M.C. (McMaster Univ., Hamilton, Ontario (Canada)). Jun 1980. 431p. National Library of Canada, Canadian Theses on Microfiche Service, Ottawa, Canada K1A 0N4.

The refilling and rewetting of a directly-heated horizontal channel has been studied experimentally. The quenching characteristics and rewetting rates were obtained under different well-defined initial and boundary conditions. The parametric effects of initial wall temperature, inlet water flow rate, and inlet water subcooling as well as effects of residual power input, tube insulation and dissolved air and ions in the inlet water were investigated. The results show that, in horizontal channels, transverse gravity forces significantly affect the hydraulic and, consequently, thermal behaviour of the system. The heat transfer mechanisms were found to vary during transients, both axially and circumferentially. A simple physical model that can account for most of the observed characteristics was developed. The model consists of an inclined rewetting front and an entrained liquid tongue extending downstream from the rewetting front. The propagation of the rewetting front appears to be largely controlled by hydrodynamic mechanisms. Surface quenching can occur at very different wall temperatures along the tube. A simplified two-fluid model was used to analyze the thermo-hydraulic processes in the present flow situation. A quench model based on a critical water level determined the transition of heat transfer mode from film boiling to transition boiling and subsequent quenching of the surface. These models were found to be quite successful in predicting the rewetting rates and details of the quenching characteristics for the refilling and rewetting experiments.

29013 **(INIS-mf—8399) Phase separation and pressure drop of two-phase flow in vertical manifolds.** Zetzmann, K. (Hannover Univ. (Germany, F.R.). Fakultaet fuer Maschinenwesen). 1982. 127p. (In German). NTIS (US Sales Only), PC A07/MF A01. Order Number DE84780200.

The splitting of a two-phase mass flow in a tube manifold results in a separation between liquid and gas phase. A study is presented of the phase distribution and the related two-phase pressure drop for vertical manifolds in the technically relevant geometry and flow parameter region of an air-water-flow. At the outlet changes in the gas/fluid-radio are observed which are proportional to this ratio at the inlet. The separation characteristic strongly depends on the massflow through the junction. Empirical equations are given to calculate the separation. Measuring the pressure drop at main- and secondary tube of the manifold the additional pressure drop can be obtained. If these results are related with the dynamic pressure at the inlet, two-phase resistance coefficients can be deduced, which may be tested by empirical relations. (orig.).

29014 **(INIS-mf—8400) Investigations of post-dryout heat transfer in case of vertical and horizontal pipe flow.** Schnittger, R.B. (Hannover Univ. (Germany, F.R.). Fakultaet fuer Maschinenwesen). 29 Jan 1982. 140p. (In German). NTIS (US Sales Only), PC A07/MF A01. Order Number DE84780201.

Experimental studies are presented of the heat transfer behaviour of a post dry-out flows in directly heated tubes of 6 m length. The wall temperatures of the tube are measured by thermocouples, which are distributed radially and axially on the outer tube surface. The vapor temperature is determined by a probe at the exit of the tube R 12 is used as a working fluid. Based on the experimental temperature distribution, the influence on pressure, mass-flow-density, and on specific thermal surface load had been studied. As a result, the heat transfer behaviour is dominated in a broad parameter range by thermal non-equilibrium conditions between the phases. Under these conditions the heat is transfered mainly from the tube wall to the vapor and from the vapor to the droplets. The strong wall temperature decrease observed at higher pressures and specific thermal surface loads after the dryout is not explained by a contact between the droplets and the tube wall, but by the decay of the droplets in the boundary layer of the wall. The non-uniform wall-temperature distribution of the horizontal tube and the lower evaporation rate compared with a vertical tube are explained by a non-uniform vapor temperature - and droplet distribution over the tube cross-section. A model is proposed for the calculation of the wall temperatures, which accounts for all these individual effects. This model can also be applied in the case of water as is demonstrated by a comparison with respective experimental results from the literature. (orig.).

29015 **(NP—4770261) Dynamics of large cross-flow heat exchangers.** Schmachtenberg, H. (Technische Hochschule Aachen (Germany, F.R.). Fakultaet fuer Maschinenwesen). 26 May 1981. 170p. (In German). NTIS (US Sales Only), PC A08/MF A01. Order Number DE84770261.

Cross-flow heat exchangers are frequently used in HVAC-systems for purposes of air-cooling, and air-heating. Control and regulation require information not only on the static but also the dynamic behaviour of these heat exchangers. This thesis aims at setting up by using analytic deduction a simple dynamic model on the temperature control system heat exchanger and water ducts, the model will be tested by experiments. The analytical model is set up from easily accessible construction data and permits estimation of the dynamic behaviour of plants in planning. Experimental countercheck is done with simple, well-proved methods of systems analysis with a large industrial air-heater of an air-conditioning system during normal operation. Comparison of analytically and experimentally obtained results shows possibilities and limits of analytical models.

29016 **(SAND—83-2576) Thin flame model for reactive flow in porous materials.** Baer, M.R.; Shepherd, J.E. (Sandia National Labs., Albuquerque, NM (USA)). Apr 1984. Contract AC04-76DP00789. 54p. NTIS, PC A04/MF A01; 1; GPO Dep. Order Number DE84011406.

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In this report we present a model for the flow processes associated with a gas-generating combustion wave propagating through a porous reactor. A one-dimensional model is constructed using a thin flame approximation. The flow is determined by the permeability of the unreacted material and the exothermicity of the combustion. Numerical calculations are presented to demonstrate various aspects of the model. In addition, analytical solutions to the flow fields are determined for the limiting cases of reactants with very high or low permeability.

29017 **(TVA/PUB—84/30) Numerical simulation of heat transfer in evaporative cooling towers.** Benton, D.J. (Tennessee Valley Authority, Norris (USA). Div. of Air and Water Resources). Sep 1983. 37p. NTIS, PC A03/MF A01. Order Number DE84901142.

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A phenomenological analysis is developed for the processes which occur within an evaporative cooling tower. This analysis includes the basic principles of mass, momentum, and energy conservation as well as empirical relationships for component characteristics such as transfer and pressure drop coefficients. Based on this analysis, a computer model which simulates the processes occurring in evaporative cooling towers was developed. The results of this computer model are compared to field data to verify the analysis and the computer modeling. The computer model may be used to analyze the performance of existing towers or to predict the performance of alternative tower designs.

29018 **(UCRL—89724) Computer codes for fluid-structure interactions.** McMaster, W.H. (Lawrence Livermore National Lab., CA (USA)). Apr 1984. Contract W-7405-ENG-48. 16p. (CONF-840647—14). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE84011068.

From ASME pressure vessel and piping conference; San Antonio, TX, USA (17 Jun 1984).

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Three fluid dynamics codes are available for the analysis of fluid-structure interactions where the fluid motion is drastic enough to cause difficulties in the Lagrangian formulation. The fluid-structure-interaction algorithms in these codes have been developed for the analysis of the dynamic response of coupled fluid-structure systems. The fluid motion is computed using an Eulerian differencing formulation and the structural motion is determined from a finite element code. The coupling is affected across the Lagrangian boundary defining the structure.

29019 (UCRL—90835) Pressure effects on wall heat transfer during flame quenching. Vosen, S.R.; Westbrook, C.K. (Lawrence Livermore National Lab., CA (USA); Sandia National Labs., Livermore, CA (USA)). 14 May 1984. Contract W-7405-ENG-48. 26p. (CONF-8404104—3). NTIS, PC A03/MF A01; GPO Dep. Order Number DE84012265.

From Spring meeting of the Combustion Institute; Boulder, CO, USA (2 Apr 1984).

A one-dimensional numerical model is used to predict rates of time-dependent wall heat transfer in high temperature and high pressure combustion chambers. Laminar flow near the cold wall is assumed, and global chemical kinetic mechanisms are used to describe the combustion of methane-air and propane-air mixtures. The effects of variations in fuel type, pressure, equivalence ratio, and thermal boundary layers on the wall heat flux are examined, and the calculated results are correlated in terms of characteristic time and energy units.

29020 Fabrication and leak-tight furnace brazing of intricate objects. Swift, G.W.; Migliori, A.; Wheatley, J.; Waller, C.R.; Suazo, G. (Los Alamos National Laboratory, Los Alamos, New Mexico 87545). *Review of Scientific Instruments;* **55**: No. 5, 793-795(May 1984).

An extremely compact crossflow heat exchanger has been constructed by hydrogen furnace brazing together a stack of hundreds of chemically milled stainless-steel sheets. The resulting structure is leak tight and very strong, but fluid channels as small as 51 μm are not plugged by excess brazing material. The construction technique is easily adapted to mass production and should be useful for structures of an intricate but repetitive three-dimensional nature.

29021 Void/particulate detector. Claytor, T.N.; Karplus, H.B. (to Dept. of Energy). US Patent Application 6-535,979. 26 Sep 1983. 14p. Contract W-31-109-ENG-38.

Apparatus for detecting voids and particulates in a flowing stream of fluid contained in a pipe may comprise: (a) a transducer for transmitting an ultrasonic signal into the stream, coupled to the pipe at a first location; (b) a second transducer for detecting the through-transmission of said signal, coupled to the pipe at a second location; (c) a third transducer for detecting the back-scattering of said signal, coupled to the pipe at a third location, said third location being upstream from said first location; (d) circuit means for normalizing the back-scattered signal from said third transducer to the through-transmitted signal from said second transducer; which normalized signal provides a measure of the voids and particulates flowing past said first location.

29022 Shock wave absorber having a deformable liner. Youngdahl, C.K.; Wiedermann, A.H.; Shin, Y.W.; Kot, C.A.; Ockert, C.E. (to Dept. of Energy). US Patent Application 6-526,767. 26 Aug 1983. 18p. Contract W-31-109-ENG-38.

This invention discloses a shock wave absorber for a piping system carrying liquid. The absorber has a plastically deformable liner defining the normal flow boundary for an axial segment of the piping system, and a nondeformable housing is spaced outwardly from the liner so as to define a gas-tight space therebetween. The flow capacity of the liner generally corresponds to the flow capacity of the piping system line, but the liner has a noncircular cross section and extends axially of the piping system line a distance between one and twenty times the diameter thereof. Gas pressurizes the gas-tight space equal to the normal liquid pressure in the piping system. The liner has sufficient structural capacity to withstand between one and one-half and two times this normal liquid pressures; but at greater pressures it begins to plastically deform initially with respect to shape to a more circular cross section, and then with respect to material extension by circumferentially stretching the wall of the liner. A high energy shock wave passing through the liner thus plastically deforms the liner radially into the gas space and progressively also as needed in the axial direction of the shock wave to minimize transmission of the shock wave beyond the absorber.

4205 Materials Testing

REFER ALSO TO CITATION(S) 28252, 28345, 29005, 29166

29023 (CEA-CONF—6834) Radiography of heavy materials with a 420 kV X ray generator. Bourdarios, G.; Deleuze, M.; Lemoine, P. (CEA Centre d'Etudes de Bruyeres-le-Chatel, 92 - Montrouge (France)). Mar 1983. 30p. (In French). (CONF-8303119—1). NTIS (US Sales Only), PC A03/MF A01. Order Number DE84750659.

From Meeting on non destructive testing; Paris, France (23 Mar 1983).

The aim of this study is the improvement of X ray testing. The installation is described and tests are carried out with uranium samples up to 9 mm thick. Performances are compared with examination by a Ir 192 source: contrast is enhanced and exposure time is reduced (12 graphs and 6 tables).

29024 (CEA-CONF—6835) Application of gamma absorptiometry to nondestructive testing. Bergey, C.; Lefevre, C.; Tailland, C. (CEA Centre d'Etudes de Bruyeres-le-Chatel, 92 - Montrouge (France)). Jun 1983. 7p. (In French). (CONF-8305152—10). NTIS (US Sales Only), PC A02/MF A01. Order Number DE84750657.

From 5. international congress on non-destructive control methods; Bordeaux, France (30 May 1983).

Thickness or density of materials are determined by direct measurement of intensity attenuation of a collimated gamma beam from a Ir 192 source with uranium samples 2 mm thick. Performance of the method is presented in this paper. Reliability, sensitivity and resolution are studied. Thickness variations of 2 μm are detected but measurement are made on a small surface; time required for a good accuracy is about 300 secondes.

29025 (CEA-CONF—6836) Repartition of ultrasonic energies at the interfaces. Deleuze, M.; Bourdarios, M.; Lepoutre, M. (CEA Centre d'Etudes de Bruyeres-le-Chatel, 92 - Montrouge (France)). Jun 1983. 17p. (In French). (CONF-8305152—8). NTIS (US Sales Only), PC A02/MF A01. Order Number DE84750644.

From 5. international congress on non-destructive control methods; Bordeaux, France (30 May 1983).

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Energy repartition of ultrasonic waves at the interfaces is studied as a function of incidence angle of the acoustic beam in immersion testing. For each interface type mathematical relations give the ratio of incident energy and energy of the wave reemitted by the interface. As an example curves for the interfaces water-uranium are given.

29026 (CEA-CONF—6837) Radiographic and radioscopic testing of coatings with a high absorption coefficient. Bourdarios, M.; Deleuze, M.; Lepoutre, M. (CEA Centre d'Etudes de Bruyeres-le-Chatel, 92 - Montrouge (France)). Jun 1983. 13p. (In French). (CONF-8305152—9). NTIS (US Sales Only), PC A02/MF A01. Order Number DE84750656.

From 5. international congress on non-destructive control methods; Bordeaux, France (30 May 1983).

Radiographies of a uranium disk obtained with an Ir 192 source and a X-ray generator of 420kV are compared. Then a testing installation with a X-ray generator for high absorption material is studied. It comprises a mechanism to put the sample into position and a system for image processing to improve contrast and decrease background noise.

29027 (CEA-CONF—6838) Use of a medical tomodensimeter in quality control. Thiery, C.; Lefevre, H.; Godement, A. (CEA Centre d'Etudes de Bruyeres-le-Chatel, 92 - Montrouge (France)). Jun 1983. 8p. (In French). (CONF-8305152—11). NTIS (US Sales Only), PC A02/MF A01. Order Number DE84750658.

From 5. international congress on non-destructive control methods; Bordeaux, France (30 May 1983).

Adaptation of X ray tomography in industry is examined for the determination of density variations when the absorption coefficient is known. Reproducibility, influence of size, importance of photon quantity, energy spectra and filtration are studied for optimization. Examples concerning density of graphite parts, homogeneity of beryllium parts and defects detection are given.

29028 **(CEA-CONF—6907) Acoustic emission on stressed concrete.** Jamet, P.; Birac, C.; Prunelle, D. de; Contre, M.; Astruc, M.; Kavyrchine, M. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France)). Aug 1983. 1p. (CONF-830805—85). NTIS (US Sales Only), PC A02/MF A01. Order Number DE84750642.

From 7. international conference on structural mechanics in reactor technology; Chicago, IL, USA (22 Aug 1983).

In a first part of this study, a comparison is made between the mechanical behaviour and the acoustic emission measurements on laboratory specimen during four points bending tests. The specimen were made of plain or/and reinforced concrete. The second part confirms, on real reinforced beams, the laboratory study results.

29029 **(CEA-CONF—7017) Contribution to industrial X-ray tomography.** Huet, J.; Thomas, G. (CEA Centre d'Etudes de Vaujours, 93 - Sevran (France); CEA Centre d'Etudes Nucleaires de Grenoble, 38 (France)). Jun 1983. 5p. (In French). (CONF-8305152—12). NTIS (US Sales Only), PC A02/MF A01. Order Number DE84750675.

From 5. international congress on non-destructive control methods; Bordeaux, France (30 May 1983).

Based on the previous experience on medical scanner, a prototype of industrial X-Ray scanner has been studied and realized by the CEA. This apparatus uses a 420 kVolts generator as a beam source. The results obtained are shown. The characteristics of a flexible and polyvalent system well adapted to industrial testing are defined.

29030 **(NUREG/CR—3753) Evaluation of manual ultrasonic inspection of cast stainless steel piping.** Taylor, T.T. (Pacific Northwest Lab., Richland, WA (USA)). May 1984. Contract AC06-76RL01830. 30p. (PNL—5070). NTIS, PC A03/MF A01; 1 - GPO $3.75; GPO Dep. Order Number DE84012816.

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Two studies have attempted to determine the degree of inspectability of centrifugally cast stainless steel (CCSS) pipe. In one study, Westinghouse examined the reliability of ultrasonic test methods in the detection of mechanical fatigue cracks. The second study was an NRC-sponsored Pipe Inspection Round Robin (PIRR) test conducted at Pacific Northwest Laboratory (PNL). The Westinghouse study reported that 80% detection was achieved for mechanical fatigue cracks having 20% throughwall depth. The PNL study reported that less than 30% detection was achieved for thermal fatigue cracks ranging from 5% to 50% through-wall. A cooperative program between PNL and Westinghouse was conducted to resolve the differences between the two studies. The program was designed as a limited round robin. Detection experiments were performed on samples from both the PNL and Westinghouse studies. The data reported here indicate that flaw type (thermal fatigue versus mechanical fatigue) was a significant factor in detection. Mechanical fatigue cracks were more easily detected than thermal fatigue cracks. The data conclusively show that manual ultrasonic inspection cannot size flaws in cast stainless steel material. The study recommends that ultrasonic inspection of cast stainless steel pipe be continued because cracks caused by some failure mechanisms (i.e., mechanical fatigue cracks) have proven to be detectable.

29031 **(UCRL—88273) Comprehensive guide to the literature on acoustic emission from composites.** Drouillard, T.F.; Hamstad, M.A. (Rockwell International Corp., Golden, CO (USA). Rocky Flats Plant; Lawrence Livermore National Lab., CA (USA)). 16 May 1983. Contract AC04-76DP03533;W-7405-ENG-48. 63p. (CONF-830755—2). NTIS, PC A04/MF A01; 1; GPO Dep. Order Number DE84011064.

From 1. international symposium on acoustic emmision from composites; San Francisco, CA, USA (19 Jul 1983).

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A comprehensive bibliography has been compiled on the subject of acoustic emission (AE) from composites. More than 300 references are presented. To facilitate usage of this bibliography, author and subject indexes have been developed to help the user easily find significant references in different areas of interest. Also listed are the organizations and authors where the major research, development, and application of acoustic emission from composites has been carried on. All references have been rated by the approximate percentage of the reference devoted to acoustic emission from composites. The intent of this format is to provide a document so that the user does not have to sort through the entire literature to find the material pertinent to his particular area of interest.

29032 **(Y/DW—489) User's guide to Sphere and Plate Interactive Display Routine (SPIDR).** Bell, Z.W. (Oak Ridge Y-12 Plant, TN (USA)). 29 May 1984. Contract AC05-84OS21400. 104p. NTIS, PC A06/MF A01; 1; GPO Dep. Order Number DE84012855.

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An interactive graphics display program capable of producing axonometric views of three-dimensional data is described. The mathematics of the projection transformation is given. Descriptions of the individual program modules are given, and a user's manual is provided.

29033 **Method and apparatus for measuring stress.** Thompson, R.B. (to Dept. of Energy). US Patent Application 6-518,243. 28 Jul 1983. 18p. Contract W-7405-ENG-82.

A method and apparatus for determining stress in a material independent of micro-structural variations and anisotropies. The method comprises comparing the velocities of two horizontally polarized and horizontally propagating ultrasonic shear waves with interchanged directions of propagation and polarization. The apparatus for carrying out the method comprises periodic permanent magnet-electromagnetic acoustic transducers for generating and detecting the shear waves and means for determining the wave velocities.

29034 **Crack mapping by ray methods.** Achenbach, J.D.; Ahlberg, L.; Norris, A.N.; Tittmann, B.R. (The Technological Inst. Northwestern Univ. Evanston, IL 60201). pp 1097-1116 of Review of progress in quantitative nondestructive evaluation. Thompson, D.O.; Chimenti, D.E. New York, NY; Plenum Publishing Corp. (1983). (CONF-820820—). Contract W-7405-ENG-82.

From Review of progress in quantitative NDE; San Diego, CA, USA (1 Aug 1982).

Two methods to map crack edges by the use of arrival times of edge-diffracted signals--the global triangulation method and a local crack-edge mapping technique--are reviewed. The first method maps flash points on the crack edge by a process of triangulation with the source and receivers as given vertices of the triangle. The second method determines planes relative to a known base point close to the crack edge. Edge diffraction is briefly reviewed. A simple configuration is set up to illustrate the differences in accuracy of the two methods, and the superior accuracy of the local crack-edge mapping over the global triangulation method is shown. Local crack-edge mapping is tested on experimental traveltime data for a simulated elliptical crack in a spherical Ti-alloy specimen. Crack mappings of very satisfactory accuracy were acheived.

29035 **On the estimation of porosity in composites by oblique angle illumination.** Kak, A.C.; Azimi, M.; Slaney, M. (School of Electrical Engineering Purdue Univ. West Lafayette, IN 47907). pp 851-866 of Review of progress in quantitative nondestructive evaluation. Thompson, D.O.; Chimenti, D.E. New York, NY; Plenum Publishing Corp. (1983). (CONF-820820—). Contract W-7405-ENG-82.

From Review of progress in quantitative NDE; San Diego, CA, USA (1 Aug 1982).

Reported here are some preliminary computer simulation results on the feasibility of using oblique incidence ultrasound for the

detection and estimation of porosity in composites. In the oblique incidence approach, the composite is illuminated at off normal angles in such a manner that the reflected returns from the fibers are in directions away from the illuminating transducer. Since the scattered returns from porosity tend to be more omnidirectional than the fiber returns, there is a larger received signal in the presence of porosity.

29036 **Scattering by flaws in a slab or a half-space.** Visscher, W.M. (Theoretical Division, Los Alamos National Laboratory Los Alamos, NM 87545). pp 813-831 of Review of progress in quantitative nondestructive evaluation. Thompson, D.O.; Chimenti, D.E. New York, NY; Plenum Publishing Corp. (1983). (CONF-820820—).

From Review of progress in quantitative NDE; San Diego, CA, USA (1 Aug 1982).

The purpose of the present report is to explain, via a simple scalar example, the principles of a general boundaryintegral-representation method which has been used to calculate scattering of waves of all polarizations by a 2d surface or subsurface crack. The method is developed for bulk defects and cracks in a slab as well as in a half-space, and is straightforwardly applicable to 3-dimensional problems as well as to 2d ones. The formalism has been developed and applied to scattering in 3d from isolated cracks. The extension to surface cracks or cracks in slabs involves considerably more algebra in 3d than in 2d, but in principle it is straightforward manipulation. The sections which follow include an explanation of the derivation of the Helmholtz integral equation (BIR--boundaryintegral-representation) for the field in the presence of a flaw, the method used to solve it in the slab and in the half-space, and an exposition of some of the problems encountered in the numerical actualization of the solution algorithm.

29037 **Measurements of ultrasonic scattering from near-surface flaws.** Hsu, D.K.; Gray, T.A.; Thompson, R.B. (Dept. of Physics Colorado State Univ. Fort Collins, CO 80523). pp 795-812 of Review of progress in quantitative nondestructive evaluation. Thompson, D.O.; Chimenti, D.E. New York, NY; Plenum Publishing Corp. (1983). (CONF-820820—). Contract W-7405-ENG-82.

From Review of progress in quantitative NDE; San Diego, CA, USA (1 Aug 1982).

In ultrasonic NDE measurements the detection of subsurface flaws is of practical importance, especially flaws too far from the surface to be detected by eddy current methods and yet close enough to the surface for the flaw-surface interaction to be important. In this paper we report experimental results of ultrasonic scattering measurements of subsurface flaws in the presence of a fluid-solid interface and compare these results with theoretical calculations of subsurface flaw scattering. Comparison of the absolute value of the scattering amplitude in terms of frequency, flaw-to-surface distance, ultrasonic mode and scattering angle will be made for an oblate spheroidal void in the interior of bulk titanium and for a spherical inclusion near the surface of a thermoplastic sample. Results of applying the one-dimensional inverse Born algorithm to the sizing of near-surface flaws are also reported.

4206 Safety Engineering

REFER ALSO TO CITATION(S) 29258

29038 **(BDX—613-3046) Evaluation of robot perimeter control devices.** Lembke, J.R. (Bendix Corp., Kansas City, MO (USA)). May 1984. Contract AC04-76DP00613. 12p. NTIS, PC A02/MF A01; GPO Dep. Order Number DE84011536.

Three types of active intrusion detection devices were used to provide perimeter control in the vicinity of working robots. The goal was to develop an effective means of ensuring personnel safety in robotic installations. The ultrasonic ranging system was found to be effective in detecting intruders and to require less obstructing equipment than other types of devices. However, false alarms were generated at a significant rate. The photo-electric system performed reliably and was generally satisfactory. The only problem with this system is that it requires floor space for pedestal-mounted mirrors, which obstruct access to the area outside the reach of the robot. The light curtain was cumbersome and difficult to install and was susceptible to false triggering caused by flashing vehicle lights and other sources of changing light level. This device has no clear advantage over the other systems evaluated. An ultrasonic ranging system and two photo-electric systems are currently in use in laboratory environments. No additional evaluation of the light curtain is planned.

29039 **(EGG-HS—6596) Halon containers - to weigh or not to weigh.** Phillips, K.C. (EG and G Idaho, Inc., Idaho Falls (USA)). Apr 1984. Contract AC07-76ID01570. 22p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE84011909.

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The National Fire Protection Association requires that the quantity of agent in Halon fire extinguishing systems be verified every six months. The accepted method for determining the quantity of agent has been weighing the containers. Because of problems involved with this method, such as the size of the containers, access, etc., the question what other alternatives are there to weighing halon containers has arisen. This report includes the evaluation and test program whereby the Fire Engineering Group selected and tested alternative methods: the thermal strip tape method, the infrared scanner, ultrasonics, and the radiation detector. Also evaluated, but not tested, were the dip stick method, the pressure supervision method, and weighing using a transducer. As a result of this program, it was determined that weighing is still the most positive method for determining agent quantity, but there are alternatives that can be used. The use of some of these alternatives will provide cost savings, time savings, and maintain the fire protection system in service. However, it will be important for the organization or company intending to use one of the alternative methods, to evaluate and make sure it is compatible with their particular halon protection system.

4208 Electronic Circuits And Devices

REFER ALSO TO CITATION(S) 28977

29040 **(AD-A—136668/1) Electromagnetic squeezer for compressing squeezable electron tunneling junctions. Technical report.** Moreland, J.; Hansma, P.K. (California Univ., Santa Barbara (USA). Dept. of Physics). Jan 1984. 23p. (TR—16). NTIS, PC A02/MF A01.

The resistance of squeezable electron tunnel junctions (SET junctions) can be adjusted with an electromagnetic squeezer. For junctions immersed in liquid helium, the resistance is stable to approximately 0.1%. This stability is sufficient for measurements of superconducting energy gaps and for superconducting phonon spectroscopy out to 50 mV applied bias. Increased stability, especially at higher biases, will be necessary for inelastic electron tunneling spectroscopy.

29041 **(BMFT-FB-T—83-286) Production oriented III-V epitaxy.** Matthes, H.; Gramann, W. (Bundesministerium fuer Forschung und Technologie, Bonn (Germany, F.R.)). Dec 1983. 62p. (In German). NTIS (US Sales Only), PC A04/MF A01. Order Number DE84751234.

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For economic and technical reasons manufacturers of LED's are increasingly being forced to fabricate their own material. Because commercial vapour phase epitaxy reactors are not available, such reactors must be developed and constructed by the manufacturers themselves. The present report describes the construction of and the results obtained from two development prototypes and two production reactors. One prototype and one production reactor for the growth of GaAssub(0,6)Psub(0,4) layers on GaAs, and the other two reactors for GaAssub(1-x)Psub(x):N (x = 0,65; 0,85) layers on GaP. With their capacity of 75 sq. in. per epitaxy, a construction which facilitates extremely clean working conditions, automatic process control and easy maintenance, these reactors satisfy most of the important requirements which are preconditions for production oriented III-V epitaxy.

29042 **(BMFT-FB-T—83-289) High speed, low power MOS-technologies.** Schuhmacher, L. (Bundesministerium fuer Forschung und Technologie, Bonn (Germany, F.R.)). Dec 1983. 62p. (In German). NTIS (US Sales Only), PC A04/MF A01. Order Number DE84751231.

Portions are illegible in microfiche products; With 17 refs., 16 figs.

Polysilicon resistor test structures of suitable size for MOS device applications were investigated and resistances in the order of 100 MΩ were measured. These resistive loads were incomponated into a static RAM cell to fabricate a 16k x 1 static RAM test vehicle in NMOS single-poly technology. The RAM offers a typical access time of 80 ns, 110 mW operating power and 15 mW standby power. To achieve extremely low power dissipation n-well CMOS technology has been investigated as an alternative to NMOS. Ring oscillators fabricated with this 2 μm high density CMOS technology showed a 0.05 pJ/gate power-delay product at Vsub(CC) = 5 V.

29043 **(CONF-840403—1) Transport properties and dielectric strengths of gas mixtures for use in diffuse discharge opening switches.** Hunter, S.R.; Carter, J.G.; Christophorou, L.G.; Lakdawala, V.K. (Oak Ridge National Lab., TN (USA)). 1984. Contract AC05-84OR21400. 15p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE84011444.

From 4. international symposium on gaseous dielectrics; Knoxville, TN, USA (29 Apr 1984).

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Gas mixtures for possible use in diffuse discharge switching applications require both high dielectric strength and specific transport properties in the conducting and the opening stages of the operation of the switch. In the conducting stage, the electron drift velocity must be large, and the electron loss processes (e.g., due to electron attachment and recombination) must be low so as to maximize the efficiency of the current gain in the discharge while maintaining low discharge impedance. In the opening stage, strong electron attachment along with high dielectric strength is required of the gas mixtures in order to extinguish the discharge as quickly as possible (and, thus, achieve a fast opening time) to prevent arcing occurring between the switch electrodes due to the high voltages induced across the switch in the opening phase. In this paper, we will present measurements of the electron drift velocity, attachment, diffusion and ionization coefficients, and high voltage dielectric strengths of several gas mixtures proposed as candidates for use in diffuse discharge switching applications. These include C_3F_8/Ar, C_3F_8/CH_4, C_2F_6/Ar, C_2F_6/CH_4, CF_4/Ar, CF_4/CH_4, CF_3OCF_3/Ar, and CF_3OCF_3/CH_4. For some of these mixtures, the above transport and dielectric strength measurements have been performed over the concentration range from 0 to 100% of the attaching gas in the nonattaching buffer gas.

29044 **(FERMILAB/TM—1257) Circuit board routing attachment for Fermilab Gerber plotter.** Lindenmeyer, C. (Fermi National Accelerator Lab., Batavia, IL (USA)). 10 May 1984. Contract AC02-76CH03000. 3p. NTIS, PC A02/MF A01; GPO Dep. Order Number DE84012516.

A new and potentially important method of producing large circuit boards has been developed at Fermilab. A Gerber Flat Bed Plotter with an active area of 5' x 16' has been fitted with a machining head to produce a circuit board without the use of photography or chemicals. The modifications of the Gerber Plotter do not impair its use as a photoplotter or pen plotter, the machining head is merely exchanged with the standard attachments. The modifications to the program are minimal; this will be described in another report. The machining head is fitted with an air bearing motorized spindle driven at a speed of 40,000 rpm to 90,000 rpm. The spindle also is provided with air bearings on its outside diameter, offering frictionless vertical travel guidance. Vertical travel of the spindle is driven by a spring return single acting air cylinder. An adjustable hydraulic damper slows the spindle travel near the end of its downward stroke. Two programmable stops control spindle down stroke position, and limit switches are provided for position feedback to the control system. A vacuum system collects chips at the cutter head. No lubrication or regular maintenance is required. The circuit board to be fabricated is supported on a porous plastic mat which allows table vacuum to hold the board in place while allowing the cutters or drills to cut through the board without damaging the rubber platen of the plotter. The perimeter of the board must be covered to the limits of the table vacuum area used to prevent excessive leakage.

29045 **(INIS-mf—8921, pp 22) Trapping and trap generation in the gate oxides of MOS devices.** Shappir, J. (Hebrew Univ., Jerusalem (Israel)). 1983. NTIS (US Sales Only), PC A05/MF A01. Order Number DE84780235. (CONF-8303128—Summ.). TI84780235

From Israel Physical Society annual meeting; Ramat-Gan, Israel (24 Mar 1983).

29046 **(INIS-mf—8921, pp 15) Direct transmission of images through optical fibers.** Friesem, A.A. (Weizmann Inst. of Science, Rehovoth (Israel). Dept. of Electronics). 1983. NTIS (US Sales Only), PC A05/MF A01. Order Number DE84780235. (CONF-8303128—Summ.). TI84780235

From Israel Physical Society annual meeting; Ramat-Gan, Israel (24 Mar 1983).

29047 **(INIS-SU—211, pp 30-32) Programmed instrument for automatic control of training of klystron pulse amplifiers.** Azarov, A.S.; Borzhkovskij, V.F.; Vlasov, V.G.; Mukhachev, N.K.; Sinaevskij, A.D.; Solov'ev, V.S.; Stervoedov, N.G.; Frolov, A.I. (Khar'kovskij Gosudarstvennyj Univ. (Ukrainian SSR)); Akchurin, YU.I.; Antipov, K.I. (AN Ukrainskoj SSR, Kharkov. Fiziko-Tekhnicheskij Inst.). 1982. (In Russian). NTIS (US Sales Only), PC A05/MF A01. Order Number DE84780255. TI84780255

In Technique of physical experiment.

The device is described that permits to control automatically the process of clystron training according to the program recorded in its memory. The device permits to assign the clystron training regime to 97 steps; high voltage and time of stage exposure can be assigned to 399 levels. The number of break-downs for the training period and for the time of clystron operation with high voltage is registered by the counter of the amount of ruptures for 999 counts and time counter of clystron operation with high voltage for 24 hours. The input of the program is done by the operator from a keyboard which is on the front panel. The presence of energy-independent constant memory device permits to retain the recorded system in the case of switched-off supply. After the break-down of the trained clystron and decrease of high voltage to zero, the device automatically increases it to the value at which break-down took place, and the count of training time at a given high voltage starts from zero. The current information on the clystron training regime is drawn to the numeric indication placed on the front panel, and a figure-printing device. Control of the logic of device operation is done using a test program.

29048 **(SAND—84-1029C) Multi-GHz multi-channel photonic analog data processing system.** Chang, J.; Filter, W.; Lockwood, G.; Neyer, B. (Sandia National Labs., Albuquerque, NM (USA)). 29 Apr 1984. Contract AC04-76DP00789. 5p. (CONF-8404124—5). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE84012281.

From SPIE technical symposium; Arlington, VA, USA (29 Apr 1984).

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Oscilloscopes based on the Cathode Ray Tube technology have been the basis of conventional high speed data recording at analog bandwidths greater than 200 MHz. With the advent of high bandwidth optical fibers sensors, an alternate and eventually more economical method for high speed data recording is possible. In this approach, the combined broad band characteristics of the optical fiber and the electrooptical streak camera are utilized to extend bandwidth, to limit signal degradation, and to permit synchronous multi-channel high speed data recording.

29049 **Front lighted optical tooling method and apparatus.** Stone, W.J. (to Dept. of Energy). US Patent Application 6-509,554. 30 Jun 1983. 35p. Contract AC04-76DP00613.

An optical tooling method and apparatus uses a front lighted shadowgraphic technique to enhance visual contrast of reflected

light. The apparatus includes an optical assembly including a fiducial mark, such as cross hairs, reflecting polarized light with a first polarization, a polarizing element backing the fiducial mark and a reflective surface backing the polarizing element for reflecting polarized light bypassing the fiducial mark and traveling through the polarizing element. The light reflected by the reflecting surface is directed through a second pass of the polarizing element toward the frontal direction with a polarization differing from the polarization of the light reflected by the fiducial mark. When used as a tooling target, the optical assembly may be mounted directly to a reference surface or may be secured in a mounting, such as a magnetic mounting. The optical assembly may also be mounted in a plane defining structure and used as a spherometer in conjunction with an optical depth measuring instrument.

29050 **Rigid indented cylindrical cathode for x-ray tube.** Hudgens, C.R. (to Dept. of Energy). US Patent Application 6-501,312. 3 Jun 1983. 11p. Contract AC04-76DP00053.

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A cathode assembly for a vacuum tube includes a wire filament, a straight tubular anode parallel to and surrounding the wire filament, insulating spacers for rigidly fastening the filament with respect to the anode, and with one side of the anode indented or flattened such that only one portion of the anode is heated to emitting temperatures by the filament.

4209 Waste Processing Plants And Equipment

REFER ALSO TO CITATION(S) 28669

29051 **(BMFT-FB-T—83-302) Recycling of duroplastic moulding material hardened by dispersion by means of powdering and compounding in new material.** Oppermann, M. (Bundesministerium fuer Forschung und Technologie, Bonn (Germany, F.R.)). Dec 1983. 12p. (In German). NTIS (US Sales Only), PC A02/MF A01. Order Number DE84751233.

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Hardened duroplastic recrements were powered in a two-stage operating grinding machine. The ground stock as final product had to show a grain size of 0,8 mm max. Together with new material the reclaimed product was pressed to standard rocks under different proportions of ingredients, of 10, 15 and 18%, and was checked according to DIN 7708. The tests have also been carried out by MPA Darmstadt and Messrs. Bakelite, and they did not ascertain any essential divergence of the physical characteristics to the rods from mixed material. Moreover, injection moulding tests have been carried out with mixed material, of which the proportions of ingredients complied with the conditions of the injection moulding material, tools and SG-machine. The compound share of the reclaimed product was between 12 - 22%. The apportioning and blending was undertaken directly on the processing machine.

4210 Combustion Systems

REFER ALSO TO CITATION(S) 28255, 28594, 28700

29052 **(BMFT-FB-T—83-303) Reduced electric reactance for electric arc furnaces.** Kasper, R. (Bundesministerium fuer Forschung und Technologie, Bonn (Germany, F.R.)). Dec 1983. 18p. (In German). NTIS (US Sales Only), PC A02/MF A01. Order Number DE84751226.

Portions are illegible in microfiche products; With 2 refs.

The reduction of the high current circuit reactance of 3-phase electric arc furnaces will increase the thermoelectric efficiency. This improvement is expected to result in savings of electricity and other consumables as well as in reduced network turbulations. The reactance can be decreased by shortening or completely eliminating the flexible high current cables. In order to still allow for the necessary tilting movements of the furnaces when tapping, disconnecting separations are designed permitting a mechanical separation of the high current circuit during this current-free situation. The proposed designs have not been tested in practical operation.

29053 **The impact of New Source Performance Standards on advanced industrial energy technology.** Streets, D.G.; Grogan, P.J. (Energy and Environmental Systems Division Argonne National Laboratory Argonne, Illinois). *Alternative Energy Sources;* 9: 331-351(Dec 1980). (CONF-801210—).

From 3. Miami international conference on alternative energy sources; Miami Beach, FL, USA (15 Dec 1980).

When Congress revised the requirements for New Source Performance Standards (NSPS) under the Clean Air Act Amendments of 1977, it defined a technological system of continuous emission reduction to include not only postcombustion cleanup processes and pretreatment of fuels, but also new energy technologies that are inherently nonpolluting. The possibility of waivers for certain innovative technologies was also included. When EPA promulgated NSPS for utility boilers, the concept of commercial demonstration permits was introduced, as a result of which certain innovative technologies were exempted from meeting the full standard for the first several thousand MW of capacity. This paper addresses whether certain advanced energy technologies could meet the kinds of NSPS currently being discussed for conventional steam generators in industry or what alternative approaches are preferable. Of particular interest to this work is cogeneration, because of its energy conservation potential, and fluidized-bed combustion, because of its favorable emissions characteristics. This work summarizes relevant market analysis for these technologies and estimates the effect of various regulatory options on market penetration. These regulatory options include the possibility of temporary waivers or exemptions, relaxed standards, and full standards.

4220 Underground Engineering

29054 **(SAND—84-0020) Experimental studies of salt cavity leaching via fresh-water injection.** Reda, D.C.; Russo, A.J. (Sandia National Labs., Albuquerque, NM (USA)). Mar 1984. Contract AC04-76DP00789. 33p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE84011789.

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Salt cavity leaching experiments were conducted in the laboratory in support of the U.S. Strategic Petroleum Reserve (SPR) program. Cavities of an initial cylindrical geometry were created by machining salt cores from one end, leaving the circular wall and bottom as an integral piece. In each of three separate experiments, a salt cavity was placed vertically in a pressure vessel and its interior filled with saturated brine. The vessel was sealed and pressurized to actual SPR-cavern pressure. Fresh water was injected down a tube and into the cavity, while brine was simultaneously removed from the cavity through a second tube. Both direct (injection below withdrawal) and reverse (injection above withdrawal) leaching procedures were investigated for essentially the same flowrate conditions and total withdrawal time. A traversable gamma-beam densitometer was positioned between the injection and withdrawal locations in each case, and was used as a non-intrusive diagnostic technique to investigate transient phenomena which occurred during the leaching, and postleaching (return-to-equilibrium) periods. Beam attenuation measurements yielded a quantitative measure of two (combined) effects: (1) the total (time-integrated) salt-wall recession and (2) the instantaneous (path length-averaged) brine salinity. Final cavity shapes were measured both by gamma-beam densitometry and by sectioning/micrometer techniques. Transient and steady-state measurements were then compared with numerical predictions, generated with SANSMIC (the Sandia Solution-Mining Code), in order to assist in the qualification of this code for actual SPR-cavern applications. Experimental results and numerical predictions were found to be in good agreement.

4230 Marine Engineering

REFER ALSO TO CITATION(S) 27848

4240 Pollution Control Equipment

REFER ALSO TO CITATION(S) 27793, 27794, 27795, 27796, 28253, 29156

4250 Power Cycles

29055 **(CONF-8405138—1) Technical support for coal-fired gas turbine development effort.** (Argonne National Lab., IL (USA)). 9 Apr 1984. Contract W-31-109-ENG-38. 23p. NTIS, PC A02/MF A01; GPO Dep. Order Number DE84012103.

From 4. DOE heat engines contractors' meeting; Morgantown, WV, USA (1 May 1984).

This task has been undertaken to support the development of combined cycle plants fired by ultra-clean coal-water mixture or dirty coal-derived low to medium Btu gas. The specific objectives of the task are to develop analytical models that can be used to study for the two combined cycle plant concepts, the influence of operating conditions such as coal cleaning, slurry composition, combustion temperature, turbine firing temperature and blade cooling, on the potential corrosion, erosion and fouling of turbine blades. Accordingly, mechanistic models for vaporization, condensation and deposition have been developed that can trace the fate of the alkali species and fly ash particles from the combustor or gasifier through the gas turbine. Taken together, the models can predict the vaporization of the alkali species (sodium and potassium) and other mineral matter (silicon, magnesium, calcium, iron, aluminum, sulfur, chlorine) from coal during combustion; subsequent condensation of ash (SiO_2, MgO, CaO, FeO/Fe_2O_3) and alkali vapor (Na_2SO_4, K_2SO_4) through the processes of homogeneous and heterogeneous nucleation; deposition of ash, nucleated and entrained, and alkali sulfate particles on the pressure and suction surfaces of turbine blades due to Brownian diffusion, thermophoresis and turbulence impingement; vapor deposition of alkali sulfates on turbine blades; and inertial impingement of entrained ash particles on turbine blades.

29056 **(PB—84-148055) Stirling engine applications study. Final report Jan-Dec 82.** Hanson, K.L.; Eckard, S.E.; McCarthy, R.; Spera, R.; Antoniak, Z. (General Electric Co., Philadelphia, PA (USA). Advanced Energy Programs Dept.). Aug 1983. 236p. (GE—82AEP022). NTIS, PC A11/MF A01.

A comprehensive survey of the potential applications for gas-fired, stationary Stirling engines was conducted. Engine characteristics were determined from a literature search and personal contacts. Such attributes as multi-fuel capability, low emissions (noise and chemical pollutants), and good part load efficiency were verified. Its thermal efficiency (demonstrated and potential) was found to be approximately equal to the diesel engine. Its potential cost is estimated to exceed that of a diesel engine and long life, reliability, and low maintenance attributes have not yet been established.

43 PARTICLE ACCELERATORS

4301 Design, Development, And Operation

REFER ALSO TO CITATION(S) 29076, 29114

29057 **(BNL—34706) Design, fabrication, and testing of the BNL radio frequency quadrupole accelerator.** Brown, H.; Clifford, T.; Giordano, S.; Khiari, F.; McKenzie-Wilson, R.; Puglisi, M.; Warner, P. (Brookhaven National Lab., Upton, NY (USA)). 1984. Contract AC02-76CH00016. 4p. (CONF-840529—25). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE84011915.

From Linear accelerator conference; Darmstadt-Seeheim, F.R. Germany (7 May 1984).

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The Brookhaven National Laboratory polarized H^- injection program for the AGS utilizes a Radio Frequency Quadrupole Accelerator for acceleration between the polarized source and the Alvarez Linac. Although operation has commenced with a few μ amperes of H^- beam, it is anticipated that future polarized H^- sources will have a considerably improved output. The RFQ will operate at 201.25 MHz and will be capable of handling a beam current of 0.02 amperes with a duty cycle of 0.25%. The resulting low average power has allowed novel solutions to the problems of vane alignment, rf current contacts, and removal of heat from the vanes. The design philosophy, details of cavity fabrication, and vane machining will be discussed. Results of low and high power rf testing will be presented together with the initial results of operations in the polarized H^- beam line.

29058 **(CONF-840529—32) Concept of a superconducting linac for low-velocity ions.** Bollinger, L.M.; Shepard, K.W. (Argonne National Lab., IL (USA)). May 1984. Contract W-31-109-ENG-38. 4p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE84011740.

From Linear accelerator conference; Darmstadt-Seeheim, F.R. Germany (7 May 1984).

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A very low velocity superconducting heavy-ion linac is proposed which, at least for applications requiring modest beam current, seems to have substantial cost and performance advantages over existing low-velocity room-temperature structures. The proposed linac, together with a 350 kV positive ion source, would replace an FN tandem Van de Graaff accelerator as the injector of the Argonne superconducting heavy-ion linac. 7 references, 5 figures.

29059 **(CONF-8404143—4) Present status and probable future capabilities of heavy-ion linear accelerators.** Bollinger, L.M. (Argonne National Lab., IL (USA)). 30 Apr 1984. Contract W-31-109-ENG-38. 7p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE84011741.

From 10. international conference on cyclotrons and their applications; East Lansing, MI, USA (30 Apr 1984).

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The general characteristics of heavy-ion linacs are summarized, with emphasis on the similarities and differences of systems based on different technologies. The main design considerations of superconducting linacs are outlined, the many projects based on this technology are listed, and a new concept for a superconducting injector linac is described. The role of RFQ structures for heavy-ion acceleration is summarized. A concluding section lists some probable applications of heavy-ion accelerators during the next decade. 17 references, 5 figures, 1 table.

29060 **(DOE/SF/00515—T29) Consequences for SLC of using full beam power in shielding design.** Jenkins, T.M. (Stanford Linear Accelerator Center, CA (USA)). 5 Jan 1984. Contract AC03-76SF00515. 2p. NTIS, PC A02/MF A01; GPO Dep. Order Number DE84012388.

With SLC's high current density (high current in a very small cross sectional area) capable of melting through the beam pipe itself, it becomes necessary to monitor, and shut-off the next pulse if the preceding pulse didn't make it all the way to the end of the SLC line. This monitoring presumably would be done with one or more current comparators. Such comparators, however, are reliably good only to about 20%; that is, they will recognize as a fault that only 70% of the beam arrived at the end (while 30% did not), and shut off the next pulse. But they won't recognize that only 80% of the beam arrived (while 20% did not) as a fault. Thus, even though the machine will shut itself off on a pulse-to-pulse basis, it will do so only when beam power drops below 80% of its initial value. Thus, if comparators were added as a part of the PPS, at best they would reduce the maximum power loss from 200 kW to 20% of that value, or 40 kW. This leads to the question, how does decreasing the maximum power loss affect shielding, and what are the consequences to SLAC (i.e., in terms of space and money). The following sections give some numbers (summarized in Table I) which will aid the machine designers in answering this question.

29061 **(INIS-SU—211) Technique of physical experiment.** (AN Ukrainskoj SSR, Kharkov. Fiziko-Tekhnicheskij Inst.). 1982. 60p. (In Russian). NTIS (US Sales Only), PC A04/MF A01. Order Number DE84780255.

Separate entries were made in the data base for the papers included. (WHK)

29062 **(LA-UR—84-1306) Status report on FMIT.** Armstrong, D.D. (Los Alamos National Lab., NM (USA)). Apr 1984. Contract W-7405-ENG-36. 3p. (CONF-840529—22). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE84011375.

From Linear accelerator conference; Darmstadt-Seeheim, F.R. Germany (7 May 1984).

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The Fusion Materials Irradiation Test (FMIT) Facility will use a 35-MeV deuteron beam and molten lithium target to generate 14-MeV neutrons for materials damage studies. Operation of the 2-MeV accelerator began in May 1983 and lasted until November. RFQ operation using pulsed rf power demonstrated the basic integrity of the design by producing a 2-MeV beam with acceptable transmission efficiency. In the evolution towards cw operation, a few areas with inadequate thermal characteristics were identified. During the 3-month period following November, the RFQ was disassembled to replace an overheated O-ring that had led to a loss of vacuum integrity in November and to make minor improvements that will enhance the thermal stability of the RFQ. Improved methods for tuning both the manifold and core tanks were developed. Resumption of testing began in March 1984. The design of the components required to extend the accelertor to 5-MeV is complete. The design of the linac tanks for the 35-MeV accelerator is complete. Procurement of these tanks and the design and procurement of the remaining 35-MeV components will be initiated as soon as funding becomes available.

29063 **(LA-UR—84-1359) New directions in linear accelerators.** Jameson, R.A. (Los Alamos National Lab., NM (USA)). 1984. Contract W-7405-ENG-36. 7p. (CONF-840529—15). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE84011412.

From Linear accelerator conference; Darmstadt-Seeheim, F.R. Germany (7 May 1984).

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Current work on linear particle accelerators is placed in historical and physics contexts, and applications driving the state of the art are discussed. Future needs and the ways they may force development are outlined in terms of exciting R and D challenges presented to today's accelerator designers. 23 references, 7 figures.

29064 **(LA-UR—84-1375) Introduction to RFQ session.** Jameson, R.A. (Los Alamos National Lab., NM (USA)). 1984. Contract W-7405-ENG-36. 5p. (CONF-840529—16). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE84011415.

From Linear accelerator conference; Darmstadt-Seeheim, F.R. Germany (7 May 1984).

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It has been close to 15 years now since our colleagues I.M. Kapchinskii and V.A. Teplyakov in the USSR conceived their spatially uniform-focusing idea in the form of practical circuits for focusing and accelerating low-velocity ion beams using electrostatic fields. Almost seven years ago, J.J. Manca whetted our curiosity at Los Alamos by pointing out from Kapchinskii and Teplyakov's work a structure that could capture nearly 100% of an ion beam injected at a few tens of keV/nucleon and accelerate it with little emittance growth to a few MeV. Now the accelerator community at large has realized that a revolution has taken place, and almost everyone is involved. At the 1981 Linac Conference at Bishop's Lodge in Santa Fe, about 17 papers dealt with aspects of the radio-frequency quadrupole (RFQ) structure, as it has also come to be known. This is a brief review of the technology. 2 references, 9 figures.

29065 **(SLAC-PUB—3221) Elementary principles of linear accelerators.** Loew, G.A.; Talman, R. (Stanford Linear Accelerator Center, CA (USA); Cornell Univ., Ithaca, NY (USA). Lab. of Nuclear Studies). Sep 1983. Contract AC03-76SF00515. 46p. (CONF-8208147—5). NTIS, PC A03/MF A01; GPO Dep. Order Number DE84007911.

From SLAC summer school on high-energy particle accelerators; Stanford, CA, USA (2 Aug 1982).

These lectures come in five sections. The first is this introduction. The second is a short chronology of what are viewed as important milestones in the field. The third covers proton linacs. It introduces elementary concepts such as transit time, shunt impedance, and Q. Critical issues such as phase stability and transverse forces are discussed. The fourth section contains an elementary discussion of waveguide accelerating structures. It can be regarded as an introduction to some of the more advanced treatments of the subject. The final section is devoted to electron accelerators. Taking SLAC as an example, various topics are discussed such as structure design, choice of parameters, frequency optimization, beam current, emittance, bunch length and beam loading. Recent developments and future challenges are mentioned briefly. 41 figures, 4 tables.

29066 **(UCRL—90708) Electromagnetic dissociation of radioactive heavy-ion beams.** Berman, B.L. (Lawrence Livermore National Lab., CA (USA)). Apr 1984. Contract W-7405-ENG-48. 6p. (CONF-8404154—1). NTIS, PC A02/MF A01; GPO Dep. Order Number DE84012266.

From Workshop on prospects for research with radioactive beams from heavy-ion accelerators; Washington, DC, USA (26 Apr 1984).

Based on our experience with electromagnetic dissociation of relativistic stable ions, we discuss the prospects for experiments with beams of relativistic radioactive heavy ions.

4302 Beam Dynamics, Field Calculations, And Ion Optics

REFER ALSO TO CITATION(S) 29001, 29103, 29108

29067 **(CEA-CONF—6973) Calculation of the heavy ion Saclay tandem post accelerator beams.** Valero, S.; Cauvin, B.; Fouan, J.P.; Lapostolle, P.M. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France); Grand Accelerateur National d'Ions Lourds (GANIL), 14 - Caen (France)). Sep 1983. 7p. (CONF-8309144—9). NTIS (US Sales Only), PC A02/MF A01. Order Number DE84750613.

From EPS conference on computing in accelerator design and operation; Berlin, F.R. Germany (20 Sep 1983).

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The funding for the construction of a superconducting linear postaccelerator for the Saclay 9 MeV FN Tandem started mid 1981. The output energies from ^{12}C (14 MeV/A) to ^{72}Ge (7 MeV/A) and the beam qualities will be equivalent to those of a 25 MeV Tandem with two strippers. Excellent energy or time resolution are also available from such independent cavities linac. In the present paper, optics and dynamics of the machine are discussed.

29068 **(FERMILAB/TM—1258) Main ring bunch narrowing for anti p production without rf counterphasing.** Griffin, J.; MacLachlan, J. (Fermi National Accelerator Lab., Batavia, IL (USA)). May 1984. Contract AC02-76CH03000. 9p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE84012517.

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We describe a technique for generating narrow proton bunches for anti p production without counterphasing the Main Ring rf. This procedure is apparently as effective as the previously proposed procedure and it offers several advantages. 5 figures.

29069 (INIS-mf—8921, pp 55) **Uniform integral representation for geometric optics solutions near caustics.** Hazak, G. (Israel Atomic Energy Commission, Beersheba. Nuclear Research Center-Negev); Bernstein, I.B. (Yale Univ., New Haven, CT (USA). Dept. of Physics); Friedland, L. (Hebrew Univ., Jerusalem (Israel). Racah Inst. of Physics). 1983. NTIS (US Sales Only), PC A05/MF A01. Order Number DE84780235. (CONF-8303128—Summ.). TI84780235

From Israel Physical Society annual meeting; Ramat-Gan, Israel (24 Mar 1983).

29070 **(LA-UR—84-1277) Operational parameters of a 2.0-MeV RFQ linac.** Sander, O.R.; Purser, F.O.; Rusthoi, D.P. (Los Alamos National Lab., NM (USA)). 7 May 1984. Contract W-7405-ENG-36. 3p. (CONF-840529—19). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE84011368.

From Linear accelerator conference; Darmstadt-Seeheim, F.R. Germany (7 May 1984).

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After extensive upgrading, our radio-frequency quadrupole (RFQ) linac is again installed on the accelerator test stand (ATS). The measured parameters of the RFQ, such as the output transverse emittance, transmitted beam, average energy, and energy spread is presented.

29071 **(LA-UR—84-1281) RFQ radial matching sections and fringe fields.** Crandall, K.R. (Los Alamos National Lab., NM (USA)). Apr 1984. Contract W-7405-ENG-36. 4p. (CONF-840529—23). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE84011408.

From Linear accelerator conference; Darmstadt-Seeheim, F.R. Germany (7 May 1984).

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The entrance radial matching section is an extremely important part of any radio-frequency quadrupole (RFQ) linac. It allows a beam having time-independent characteristics to become adapted to the time-dependent focusing in the RFQ. The matching sections proposed in this paper are defined by a four-term potential function and are very effective over lengths of 3 $\beta\lambda$ or longer. The fringe field at the RFQ exit is mainly of interest because of the time-varying on-axis potential. The beam can either lose or gain energy, depending on the shape of the fringe field. The same four-term potential function can be used for shaping the vanes at the exit so that the fringe fields can be controlled. This formulation also applies to exit radial matching sections, which would be useful if the beam is to enter another RFQ operated at a higher frequency. 4 references, 4 figures.

29072 **(LA-UR—84-1307) Electron motion in solenoidal magnetic fields using a first order symplectic integration algorithm.** Fraser, J.S. (Los Alamos National Lab., NM (USA)). 7 May 1984. Contract W-7405-ENG-48. 4p. (CONF-840529—20). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE84011341.

From Linear accelerator conference; Darmstadt-Seeheim, F.R. Germany (7 May 1984).

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The use of nonsymplectic procedures in particle tracing codes for relativistic electrons leads to errors that can be reduced only at the expense of using very small integration steps. More accurate results are obtained with symplectic transformations for position and momentum. A first-order symplectic integration procedure requires an iterative calculation of the new position coordinates using the old momenta, but the process usually converges in three or four steps. A first-order symplectic algorithm has been coded for cylindrical as well as Cartesian coordinates using the relativistic equations of motion with Hamiltonian variables. The procedure is applied to the steering of a beam of 80-keV electrons by a weak transverse magnetic field superposed on a strong magnetic field in the axial direction. The steering motion is shown to be parallel to the transverse field rather than perpendicular as would be the case without the strong axial field.

29073 **(LA-UR—84-1343) RFQ simulation code.** Lysenko, W.P. (Los Alamos National Lab., NM (USA)). Apr 1984. Contract W-7405-ENG-36. 4p. (CONF-840529—17). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE84011385.

From Linear accelerator conference; Darmstadt-Seeheim, F.R. Germany (7 May 1984).

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We have developed the RFQLIB simulation system to provide a means to systematically generate the new versions of radio-frequency quadrupole (RFQ) linac simulation codes that are required by the constantly changing needs of a research environment. This integrated system simplifies keeping track of the various versions of the simulation code and makes it practical to maintain complete and up-to-date documentation. In this scheme, there is a certain standard version of the simulation code that forms a library upon which new versions are built. To generate a new version of the simulation code, the routines to be modified or added are appended to a standard command file, which contains the commands to compile the new routines and link them to the routines in the library. The library itself is rarely changed. Whenever the library is modified, however, this modification is seen by all versions of the simulation code, which actually exist as different versions of the command file. All code is written according to the rules of structured programming. Modularity is enforced by not using COMMON statements, simplifying the relation of the data flow to a hierarchy diagram. Simulation results are similar to those of the PARMTEQ code, as expected, because of the similar physical model. Different capabilities, such as those for generating beams matched in detail to the structure, are available in the new code for help in testing new ideas in designing RFQ linacs.

29074 **(SAND—84-0220) Users guide to the Li/Cu activation diagnostic.** Mix, L.P. (Sandia National Labs., Albuquerque, NM (USA)). Apr 1984. Contract AC04-76DP00789. 59p. NTIS, PC A04/MF A01; 1; GPO Dep. Order Number DE84011470.

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Calculational techniques have been developed to extend the lithium/copper proton diagnostic technique (established by R.J. Leeper) to arbitrary experimental geometries. In addition, some of the limitations, assumptions, and approximations are examined and their impact on the diagnostic's accuracy are indicated. This report contains a general review of the essential elements in a form which will make it easy to apply this diagnostic to future experiments.

29075 **(SLAC/AP—9) Proposed mini beta insertion for spear.** Wille, K. (Stanford Linear Accelerator Center, CA (USA)). Mar 1984. Contract AC03-76SF00515. 16p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE84011557.

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A significant gain in luminosity has been achieved by use of mini beta insertions implemented in several electron-positron storage rings (CESR, DORIS II, PEP, PETRA) during the last year. This concept consists of strong vertical focusing quadrupoles mounted as close as possible to the interaction point. Such an arrangement avoids the acceptance and chromaticity problems caused by an extreme focusing with the normal magnet structure, but they interfere with the particle detectors and if the detector has a magnetic field one has to protect the quadrupole from this field. In this paper a mini beta insertion for SPEAR is suggested which is rather similar to that developed for DORIS II. The essential element is a conventional iron magnet with moderate design values up to an energy of E = 4 GeV. The resulting optics allow vertical amplitude functions down to β/sub y/* = 3 cm at the interaction points. Compared to the present SPEAR optics, the mini beta optics is only different in the interaction regions but unchanged in the whole arcs. This is of great importance to the injection system which does not need any modification. The resulting gain in luminosity is calculated to be approximately a factor of four. 8 references, 13 figures, 5 tables.

29076 **(SLAC/AP—21) Computer simulation of the Lasertron.** Herrmannsfeldt, W.B. (Stanford Linear Accelerator Center, CA (USA)). Apr 1984. Contract AC03-76SF00515. 14p. NTIS, PC A02/MF A01; GPO Dep. Order Number DE84012242.

The concept of the Lasertron can be most easily described by referring to the figures. A short bunch of electrons (short in time compared to the period of an rf cycle), is emitted from the cathode and accelerated by a dc potential toward the anode. An rf cavity, located just past the anode aperture, is the output cavity. The rf frequency is determined by the pulse rate of the electron bunches. Although other types of solid-state cathodes are possible, if a photo-cathode is used, then the light source will likely be a fast pulsing laser, hence the name Lasertron. The device cannot be properly called a Laser klystron since that name implies the waves of rf current by which a dc beam is bunched. In the Lasertron, the electrons are emitted bunched and it is only necessary to accelerate them before space charge forces cause too much debunching.

29077 **(SLAC-CN—233) Klystron voltage pulse timing experiment.** Hogg, H.; Deruyter, H.; Bernstein, J. (Stanford Linear Accelerator Center, CA (USA)). 21 Jun 1983. Contract AC03-76SF00515. 9p. NTIS, PC A02; 3; GPO Dep. Order Number DE84011753.

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SLAC has always operated with the voltage pulse applied to each klystron having a flat-top at least 2.5 μs long. In this region, the voltage is held constant to +-0.5%, limiting the klystron contribution to beam energy spectrum broadening caused by phase and amplitude modulation of the rf wave travelling along the accelerator sections. Since the section filling time is 0.83 μs and the maximum beam pulse length is 1.6 μs, a minimum flat-top duration of 2.43 μs is required, which when rounded up to 2.5 μs allows for some timing error. The advent of single-bunch beam opertions for SLC, coupled with the use of the SLED pulse compression system (which produces an rf output to the accelerator which changes drastically in one section filling time) and the rapidly rising cost of electrical power experienced in recent years, have made it desirable to review the specifications of the voltage pulse supplied by the modulator to the klystron. Neglecting the possibilities of increasing modulator efficency, which are being studied by others, one can ask whether some use can be made of the energy contained in the skirts of the voltage pulse on each side of the flat top region. Results are reported from an experiment performed as a first step towards finding what penalties are paid for reducing the voltage pulse width so that the skirts encroach upon the time that the rf drive pulse is on.

29078 **(SLAC-CN—234-R1) First order comparison of numerical calculation and two different turtle input schemes to represent a SLC defocusing magnet.** Jaeger, J. (Stanford Linear Accelerator Center, CA (USA)). 14 Jul 1983. Contract AC03-76SF00515. 7p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE84011754.

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Correcting the dispersion function in the SLC north arc it turned out that backleg-windings (BLW) acting horizontally as well as BLW acting vertically have to be used. In the latter case the question arose what is the best representation of a defocusing magnet with excited BLW acting in the vertical plane for the computer code TURTLE. Two different schemes, the 14.-scheme and the 20.-scheme were studied and the TURTLE output for one ray through such a magnet compared with the numerical solution of the equation of motion; only terms of first order have been taken into account.

29079 **(SLAC-CN—236) Recommendations for on-site vibration standards.** Fischer, G.E. (Stanford Linear Accelerator Center, CA (USA)). 16 Jun 1983. Contract AC03-76SF00515. 12p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE84011756.

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Unless certain common sense precautions are observed, the luminosity of the Collider may be adversely affected by otherwise preventable ground vibrations. Previous work indicates that ground vibrations can be thought of as being caused by the sum of (a) natural and (b) cultural (i.e., man-made) effects, of which the latter can be further divided into uncontrollable and controllable. Examples of category (b) include: traffic, both on site and off site; construction activity on site and off site; assembly of equipment in nearby I.R. Halls, even footsteps in the tunnel; or continuously operating machinery. This note addresses question with respect to category (b) iv., only. As a guide, the order of magnitude of amplitudes and frequencies of presently, (on site) known noise polluters is described in relation to naturally occurring disturbances and to the tolerances required for successful Collider operation. Some methods of mitigating the effects of on site machinery are suggested. Finally, a vibration tolerance level specification is recommended as well as a mechanism to police adherence to such standards. 6 figures.

29080 **(SLAC-CN—237) Effects of superposition of detector solenoid and FFS quadrupole fields in SLC and correction methods.** Murray, J.J. (Stanford Linear Accelerator Center, CA (USA)). 25 Jul 1983. Contract AC03-76SF00515. 10p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE84012067.

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For the so-called superconducting FFS option with $L^* = 2.2$ m, the MK2 solenoid does not overlap Q1, the FFS quad nearest the IP. For the permanent magnet option with $L^* = 0.75$ m, the MK2 solenoid would overlap both Q1 and Q2. In either case an 8 m long solenoid, contemplated for the SLD detector, would overlap both Q1 and Q2. The solenoid field cannot be shielded so in an overlap region one will have a superposition of solenoid an quadrupole fields. Recently, the question was raised, What are the optical consequences when the solenoid and quad fields are superimposed? The question had not been considered before, but rough estimates suggested immediately that there might indeed be ugly consequences in terms of an enlargement of spot size at the IP. The purpose of this note is to answer the question quantitatively and to consider methods of correction of the ugly consequences.

29081 **(SLAC-CN—239) Modifications of the design of the final transformer in the FFS to accommodate lower gradients in the final quadrupole triplet.** Murray J.J. (Stanford Linear Accelerator Center, CA (USA)). 29 Jul 1983. Contract AC03-76SF00515. 3p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE84011757.

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The final transformer of the FFS includes the soft bend magnet and two symmetric quadrupole triplets. It ends at the IP. It is a telescopic transformer (meaning that its transfer matrix is diagonal) with a magnification of -1/5 in both planes. In the current design, L*, the distance between the downstream end of Q1 and the IP, is equal to 7.25 feet (2.21 m) and space is provided upstream of Q6 to accommodate a 27 foot long soft bend magnet. Satisfaction of the foregoing conditions leads to field gradients of about 19.8 kg/cm in Q1 and Q3 and 18.1 kg/cm in Q2. It now appears that it would be very difficult to attain such gradients. For practical superconducting quad designs, meaning iron-free, 5 cm bore, two-layer windings and 4.2°K, experts have estimated that gradients of at least 14 kg/cm would be reasonable. This raises the question, can the final transformer in the FFS be modified to accommodate gradients of 14 kg/cm or less and if so at what price in performance.

29082 **(SLAC-CN—240) Simulation of systematic errors in the SLC magnets.** Jaeger, J. (Stanford Linear Accelerator Center, CA (USA)). 8 Aug 1983. Contract AC03-76SF00515. 16p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE84011758.

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The distance (iron to iron) between a focusing and a defocusing magnet in the SLC-arcs is 6.7056 cm and the iron length of each of them is 2.52914 m. To represent these magnets by a hard-edge model in computer codes TRANSPORT or TURTLE the magnetic length rather than the core length of these magnets is of interest. In the present lattice the magnetic length for the field and the gradient of each of these magnets is assumed to be 2.5462 m.

29083 **(SLAC-CN—242) Mask locations in the SLC final focus region.** Cence, R.J. (Stanford Linear Accelerator Center, CA (USA)). 5 Jul 1983. Contract AC03-76SF00515. 8p. NTIS, PC A02/MF A01; GPO Dep. Order Number DE84011760.

The location of four sets of masks needed to shield against background in the final focus region of the SLC is shown. The main point of this note is to update the results of Miller and Sens taking into account the recent changes that have been made in the optics of the SLC beams. For the latest beam design we use the TRANSPORT output dated 5-13-83. This design assumes that the final bends will form an S about the interaction point and that the final quadrupoles will be superconducting and will be placed about 8 feet from the interaction point.

29084 **(SLAC-CN—243) Further effects of ions in the arcs.** Rees, J.R. (Stanford Linear Accelerator Center, CA (USA)). 17 Aug 1983. Contract AC03-76SF00515. 2p. NTIS, PC A02/MF A01; GPO Dep. Order Number DE84011761.

One of the effects of ions in the SLC arcs was considered by A.W. Chao in CN-121. He estimated that the extra betatron phase shift of particles in the tail of a bunch caused by ions produced by the head was probably tolerable, provided the vacuum was 10^{-4} torr or better. This note suggests that a more thorough study of ion effects in the arcs is warranted.

29085 **(SLAC-CN—244) Preliminary study of the positions of elements in LTR.** Hall, G. (Stanford Linear Accelerator Center, CA (USA)). 12 Aug 1983. Contract AC03-76SF00515. 5p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE84011762.

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A print-out (filename, Lebout Output, dated 07/14/83) was obtained which contains the LTR quad and bend magnet specifications actually used for final alignment. The format includes tooling ball data plus coordinates, 'X' 'Y' 'Z' in the SBO grid, defining the mechanical centers of the magnets.

29086 **(SLAC-CN—247) Optimum operating temperature for accelerator diskloaded waveguide: test results from Sector 2.** Allen, M.; Millich, A.; Schwarz, H. (Stanford Linear Accelerator Center, CA (USA)). 23 Sep 1983. Contract AC03-76SF00515. 6p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE84011775.

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To keep the accelerator structures in proper tuned condition with variable applied RF power, the Cu-temperature of the structures should be kept constant. From the specifications in CN 102, we derive that a $\Delta/PHI/ = +\text{-}10^{0}$ per ten-foot structure would be permissible to stay within a $\Delta E/E$ of 0.5%. Further measurements should be performed to prove that all structures stay within this limit under the SLC operating conditions where the average RF power level will be in the order of ten times the average power used for the present test.

29087 **(SLAC-CN—248) BPMO HISTOS plots.** Clendenin, J.; Williams, S. (Stanford Linear Accelerator Center, CA (USA)). 23 Aug 1983. Contract AC03-76SF00515. 6p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE84011774.

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Early experience (1981-1982) with jittery position measurements in the CID (Collider Injector Development) and Sector 1 BPM (beam position monitor) system led us to ask whether the source of the observed noise was in the beam or in the BPM electronics. Prior to July, 1983, the signal from each BPM strip was individually processed. It occurred to us that the signal from each strip, when normalized by the sum of the signals from the two adjacent strips, made possible two independent measurements of the beam position in the plane containing the strip. When a single parameter is measured twice, one can look at the correlation of the measurements over a statistical sample of events. This will allow one to distinguish real parameter variations from measurement errors. In this case, a strong correlation in the two measurements from a given strip indicates beam jitter, whereas a lack of correlation indicates either that there is beam jitter in the normalizing plane or that the processing electronics is noisy in at least one channel. The five possible cases are illustrated. These plots are interpreted.

29088 **(SLAC-CN—249) Phase & amplitude control system for Stanford Linear Accelerator.** Yoo, S.J. (Stanford Linear Accelerator Center, CA (USA)). 26 Sep 1983. Contract AC03-76SF00515. 92p. NTIS, PC A05/MF A01; 1; GPO Dep. Order Number DE84011773.

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The computer controlled phase and amplitude detection system measures the instantaneous phase and amplitude of a 1 micro-second 2856 MHz rf pulse at a 180 Hz rate. This will be used for phase feedback control, and also for phase and amplitude jitter measurement. The program, which was originally written by John Fox and Keith Jobe, has been modified to improve the function of the system. The software algorithms used in the measurement are described, as is the performance of the prototype phase and amplitude detector system.

29089 **(SLAC-CN—268) Positron source: first 50 nanoseconds.** Moffeit, K. (Stanford Linear Accelerator Center, CA (USA)). 22 May 1984. Contract AC03-76SF00515. 22p. NTIS, PC A02; 3; GPO Dep. Order Number DE84012179.

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These results use the program ETRANS written by Harvey Lynch. ETRANS steps positrons produced in the target through a series of elements simulating the magnetic and accelerting fields of the flux concentrator, DC solenoids, and accelerating cavities. 13 figures, 1 table.

29090 **(SLAC-PUB—3284) Acceleration of high charge density electron beams in the SLAC linac.** Sheppard, J.C.; Clendenin, J.E.; Jobe, R.K.; Lueth, V.G.; Millich, A.; Ross, M.C.; Seeman, J.T.; Stiening, R.F. (Stanford Linear Accelerator Center, CA (USA)). Jan 1984. Contract AC03-76SF00515. 4p. (CONF-840529—29). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE84012415.

From Linear accelerator conference; Darmstadt-Seeheim, F.R. Germany (7 May 1984).

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The SLAC Linear Collider (SLC) will require both electron and positron beams of very high charge density and low emittance to be accelerated to about 50 GeV in the SLAC 3-km linac. The linac is in the process of being improved to meet this requirement. The program to accelerate an electron beam of high charge density through the first third of the SLC linac is described and the experimental results are discussed. 7 references, 5 figures.

4303 Auxiliaries And Components

REFER ALSO TO CITATION(S) 28001, 28002, 28828, 29057, 29079, 29591

29091 **(BNL—34652) RGA system for the NSLS.** Schuchman, J.C.; West, L.J. (Brookhaven National Lab., Upton, NY (USA); Cornell Univ., Ithaca, NY (USA)). 1983. Contract AC02-76CH00016. 31p. (CONF-831011—7). NTIS, PC A03/MF A01; GPO Dep. Order Number DE84011563.

From American Vacuum Society symposium; Boston, MA, USA (31 Oct 1983).

The National Synchrotron Light Source (NSLS) is a synchrotron radiation source designed to provide photons for simultaneous experiments on a large number of individual beam lines. A residual gas analysis (RGA) system has been designed, and is currently being installed, which would protect the beam lines and the storage rings from contamination from any one offending beam line. The system consists of having separate analyzers, with their associated rf generators, in each beam line and storage ring. The analyzers will be multiplexed back to a central controller. A computer is used for routine monitoring and control. The analyzer chosen was the VG Instruments Model SX-200. Typical mass spec-

tra will be presented along with our specifications for the RGA and our vacuum specifications for operating a typical beam line.

29092 **(BNL—34705) Early operating experience with the Brookhaven National Laboratory radio frequency quadrupole accelerator.** Brown, H.; Clifford, T.; Giordano, S.; Khiari, F.; McKenzie-Wilson, R.; Puglisi, M.; Warner, P. (Brookhaven National Lab., Upton, NY (USA)). May 1984. Contract AC02-76CH00016. 3p. (CONF-840529—35). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE84011912.

From Linear accelerator conference; Darmstadt-Seeheim, F.R. Germany (7 May 1984).

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The Brookhaven National Laboratory polarized H^- injection program for the AGS utilizes a Radio Frequency Quadrupole (RFQ) for acceleration between the polarized H^- source and the Alvarez Linac. The RFQ accelerator is now in operation with low beam currents. The results of low and high power rf testing will be reported together with initial results of operation in the polarized H^- beam line.

29093 **(CONF-840529—33) Status report on the ATLAS superconducting linear accelerator.** Argon, J.; Benaroya, R.; Bogaty, J.; Bollinger, L.M.; Clifft, B.E.; Den Hartog, P.; Johnson, K.W.; Kutschera, W.; Markovich, P.; Nixon, J.M. (Argonne National Lab., IL (USA)). May 1984. Contract W-31-109-ENG-38. 3p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE84011729.

From Linear accelerator conference; Darmstadt-Seeheim, F.R. Germany (7 May 1984).

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ATLAS, the Argonne Tandem-Linac Accelerator System, is a project to upgrade the existing Argonne superconducting linac heavy-ion booster which began providing beams of heavy-ions for experimental nuclear research in 1979. When completed ATLAS will provide beams of heavy ions up to approximately mass 130 at energies as high as 25 MeV/A. The construction of ATLAS is approximately 60% complete. First beam from the accelerator is expected in spring of 1985.

29094 **(CONF-840529—34) Investigation of a superconducting beam splitter for atlas.** Pardo, R.C. (Argonne National Lab., IL (USA)). 1984. Contract W-31-109-ENG-38. 4p. NTIS, PC A02; 3; GPO Dep. Order Number DE84011733.

From Linear accelerator conference; Darmstadt-Seeheim, F.R. Germany (7 May 1984).

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The device which is being investigated for use as a beam splitter consists of a dipole bending magnet in which a superconducting flux shield (supertube) is placed. The supertube produces a field free region for one of the charge states while the second charge state enters the magnetic field produced by the dipole magnet and is directed toward the remainder of the ATLAS accelerator. This type of device is appealing because of its simplicity and because the two beam regions are decoupled. The superconducting flux shield is a passive device requiring only that it be cooled below the superconducting transition point for proper operation.

29095 **(DOE/CH/03000—T13) Fermilab Research Program Workbook.** Rubinstein, R. (Fermi National Accelerator Lab., Batavia, IL (USA)). May 1984. Contract AC02-76CH03000. 154p. NTIS, PC A08/MF A01; 1; GPO Dep. Order Number DE84012567.

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The Fermilab Research Program Workbook has been published annually for the past several years to assist the Physics Advisory Committee in the yearly program review conducted during its summer meeting. While this is still a major aim, it is hoped that the Workbook will also prove useful to others seeking information on the current status of Fermilab experiments and the properties of beams at the Laboratory. In addition, short summaries of approved experiments are also included.

29096 **(DOE/SF/00515—T30) Stanford Linear Accelerator Center monthly report for April 1984.** (Stanford Linear Accelerator Center, CA (USA)). Apr 1984. Contract AC03-76SF00515. 24p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE84012387.

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Operational activities for the month of April, 1984 are reported in the areas of accelerator and research operations, research area and experiment status, accelerator improvements, research division developments, PEP division developments, and publications for the month. (GHT)

29097 **(FERMILAB/TM—1256) Consecutive quenches and the safety leads.** Kuchnir, M. (Fermi National Accelerator Lab., Batavia, IL (USA)). 30 Apr 1984. Contract AC02-76CH03000. 13p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE84012515.

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The safety leads of the Energy Saver were designed to handle occasional quenches. In order to save capital investment in another system of plumbing they involve no gas cooling. In their design optimization was sought on the ratio of load capability (for a single quench) to steady state heat leak into the liquid helium environment. Reference 1 describes the design considerations and tests on a prototype made out of constanta. The actual production models are made out of 304 Stainless Steel rods 13/16″ diameter by 48.66″ long[2] wrapped in Kapton film for electrical insulation. Here the behavior of production models relevant for consecutive quenches is analyzed.

29098 **(FRNC-TH—1325) Saturne II synchroton injector parameters operation and control: computerization and optimization.** Lagniel, J.M. (Paris-6 Univ., 75 (France)). 1983. 6p. (In French). NTIS (US Sales Only), PC A02/MF A01. Order Number DE84750664.

The injector control system has been studied, aiming at the beam quality improvement, the increasing of the versatility, and a better machine availability. It has been choosen to realize the three following functions: - acquisition of the principal parameters of the process, so as to control them quickly and to be warned if one of them is wrong (monitoring); - the control of those parameters, one by one or by families (starting, operating point); - the research of an optimal control (on a model or on the process itself).

29099 **(KFK—3647) Construction and test of a polarized proton target.** Aures, R. (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Inst. fuer Kernphysik; Karlsruhe Univ. (T.H.) (Germany, F.R.). Fakultaet fuer Physik). Dec 1983. 109p. (In German). NTIS (US Sales Only), PC A06/MF A01. Order Number DE84751345.

This work describes experiments in which for the first time a proton target has been constructed which is polarized by the "brute-force" method. This method requires very low temperatures and high magnetic fields. The low temperatures (down to 10 mK) are obtained by a $^3He/^4He$ dilution refrigerator, the magnetic field (up to 9 T) is produced by a superconducting split pair magnet. The proton target has a volume of about 18 cm^3 and consists of pressed titaniumhydride powder, which has a titanium/-hydrogen ratio of 1:1,96. The hydrogen content is 1,3 mol. Titaniumhydride has the advantage of sufficient heat conductivity at low temperatures and a very high proton density. The heat conductivity of the sample is measured, with and without the presence of a magnetic field. Thermodynamical measurements and adiabatic demagnetisation experiments proved quantitatively the polarization of the protons. The polarization of the proton has been measured in a transmission experiment using polarized neutrons of 1.2 MeV. The result shows a good agreement of theoretical and actual polarization. From the results it can be concluded, that this sample can be used successfully as a polarized proton target for neutron scattering experiments to measure spin-correlations.

29100 **(LA-UR—84-1278) Instrumentation and control system for the AT-2 accelerator test stand.** Wadlinger, E.A.; Holtkamp, D.B.; Holt, H.D. (Los Alamos National Lab., NM (USA)). 7 May 1984. Contract W-7405-ENG-36. 4p. (CONF-840529—18). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE84011367.

From Linear accelerator conference; Darmstadt-Seeheim, F.R. Germany (7 May 1984).

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A data-driven subroutine package, written for our accelerator test stand (ATS), is described. This flexible package permits the rapid writing and modifying of data acquisition, control, and analysis programs for the many diverse experiments performed on the ATS. These structurally simple and easy to maintain routines help to control administratively the integrity of the ATS through the use of the database. Our operating experience indicates that the original design goals have been met. We describe the subroutines, database, and our experiences with this system.

29101 (LBL—16281, pp 427-432) **First performance tests of the Diogene detector, with alpha particles.** Gosset, J. (CEN Saclay, Gif-sur-Yvette Cedex, France). Dec 1983. NTIS, PC A99/MF A01. Order Number DE84005862. (CONF-830675—). TI84005862

From 6. high energy heavy ion study and 2. workshop on anomalons; Berkeley, CA, USA (28 Jun 1983).

The Saturne synchrotron at Saclay will soon deliver beams of heavy ions up to mass 40 at energies up to 1.2 GeV per nucleon. The first generation of experiments on central collisions of relativistic heavy ions, performed mainly at the Berkeley Bevalac with the aim to study the behaviour of nuclear matter at high density and high degree of internal excitation, has shown that inclusive measurements are too sensitive to trivial aspects such as geometry and kinematics, and not enough to the dynamics of the reactions. Only exclusive measurements can lead to some information about the dynamics and possibly on the equation of state of nuclear matter at high density and high temperature. The Diogene detector has been developed by a collaboration between physicists from Saclay, Strasbourg and Clermont-Ferrand. A solenoid made with aluminium coils and surrounded on top and bottom by an iron yoke provides a magnetic field of 1 tesla. This field is homogeneous within 1% in the whole active volume, 80 cm in length and 70 cm in diameter. Both left and right hand sides of the coil are left available for future detection of neutral particles. The detector employs a 10-sector drift chamber. Performance is described. (WHK)

29102 **(SLAC-CN—235) Temperature rise calculations for the beam pipe in the SLC arcs.** Nelson, W.R.; Jenkins, T.M. (Stanford Linear Accelerator Center, CA (USA)). 7 Jul 1983. Contract AC03-76SF00515. 8p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE84011764.

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This note presents the results of EGS calculations for 50 GeV electron beams showering in 1mm thick slabs of copper and aluminum at glancing angles. The maximum temperature rise for 50μ (Gaussian σ) beams of 5 x $10^{10}e^-$/pulse was found to increase with angle, ranging about: 300 to 700°C/pulse (copper), and 50 to 100°C/pulse (aluminum) for angles of incidence between 0.1 to 10 mradians. The results are also applicable to slabs thicker than 1mm within this angular range. For larger angles, where shower leakage out the back becomes important, the slabs were made thicker. These extended results (see last figure) are applicable for all angles of incidence and should be useful for calculating the maximum temperature rise in such devices as collimators and slits.

29103 **(SLAC-CN—241) Update on beam extraction.** Keller, L.P. (Stanford Linear Accelerator Center, CA (USA)). 26 Aug 1983. Contract AC03-76SF00515. 14p. NTIS, PC A02; 3; GPO Dep. Order Number DE84011759.

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At the time of the 1981 Workshop on Experimental Use of the SLC, we published an extraction scheme for the MINIQUAD final focus (FF) optics. Since then a different FF optics design has been selected. With the same achromat section and outboard telescope, it allows a number of options for the inboard telescope. This note describes the new extraction system and briefly considers electron-electron extraction and the consequences of an extraction kicker malfunction. 4 references, 7 figures, 1 table.

29104 **(SLAC-CN—245) Occupancy of the SLC arcs during linac operation.** Jenkins, T.M. (Stanford Linear Accelerator Center, CA (USA)). 24 Aug 1983. Contract AC03-76SF00515. 8p. NTIS, PC A02; 3; GPO Dep. Order Number DE84011763.

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In this note, we consider how close we can come to the linac along the SLC arc during linac operation. In this case, radiation will come from beam striking a beam line component in the linac transport system. Radiation actually penetrating the shielding wall between the linac and the arc isn't considered since it will be orders of magnitude smaller than radiation which enters the arc through one of two openings in the shielding: (1) the opening through which the SLC beam transport components pass; and (2) a personnel accessway some fifty seven feet downbeam of the first opening. We make the assumption that with a little judicious placing of shielding small angle radiation can be eliminated, leaving only large angle radiation (e.g., 90°) to enter the SLC arcs. The source then is essentially opposite either of the two openings. Because the personnel opening is further downbeam, it dominates the shielding requirements.

29105 **(SLAC-CN—246) Ground motion: frequency of occurrence versus amplitude of disturbing transient events.** Werner, K.L. (Stanford Linear Accelerator Center, CA (USA)). 12 Sep 1983. Contract AC03-76SF00515. 14p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE84011755.

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Successful collider operation requires that ground motion not exceed certain tolerances. In this note it is pointed out that on occasion these tolerances are exceeded. The frequency of such events and their amplitudes, measured as a function of time of day, have been measured. An examination of the data leads one to conclude that most events are of cultural (i.e., man-made) origin. 2 references, 20 figures.

29106 **(SLAC-CN—266) Survey of vibration amplitudes throughout the linac.** Werner, K.L. (Stanford Linear Accelerator Center, CA (USA)). 2 May 1984. Contract AC03-76SF00515. 7p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE84011556.

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The magnitude of vibrations of the Linac structure due to on site disturbances, such as cooling towers, pumps, generators, Highway 280 overpass traffic, is of interest. CN-263, for example, discusses tolerances of random (i.e., uncorrelated) quad jitter and suggests that amplitudes should not exceed 0.7 microns rms. This note describes the results of a series of measurements carried out in the summer of 1983. In general, the tolerance is not exceeded, but there appears not to be a good safety factor at low frequencies.

29107 **(SLAC-CN—267) Ground motion - some relative phase measurements in the PEP tunnel.** Fischer, G.E.; Werner, K. (Stanford Linear Accelerator Center, CA (USA)). 09 May 1984. Contract AC03-76SF00515. 16p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE84011887.

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The spatial as well as the temporal characteristics of ground motion are of interest when one attempts to evaluate orbit distortions resulting from time varying quadrupole displacements. In other words, one needs to know the spatial correlations of quad displacements along the orbits path. A correlation with the betatron wavelength would be, for example, potentially more dangerous than from say purely statistically uncorrelated quad motions. The space versus time relationship of ground motion is, of course, related by the effective velocity of sound in the supporting medium. The medium consists of the ground itself, the tunnel floor and the magnet support structure - the latter two having perhaps transmission line characteristics of their own. The question therefore is: What values of velocity should one use for the various types of dis-

turbances that will be encountered in practice? This note describes the results of a minimal experiment designed to answer two questions:(a) Is it at all possible to measure correlations in an existing tunnel with simple equipment? (b) Are the results consistent with the known geophysical characteristic of the site? The answer to both questions, we believe, is surprisingly, yes.

29108 **(SLAC-PUB—3285) Making electron beams for the SLC linac.** Clendenin, J.E.; Ecklund, S.D.; James, M.B.; Miller, R.H.; Sheppard, J.C.; Sodja, J.; Truher, J.B.; Minten, A. (Stanford Linear Accelerator Center, CA (USA); European Organization for Nuclear Research, Geneva (Switzerland)). Jan 1984. Contract AC03-76SF00515. 3p. (CONF-840529—30). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE84012072.

From Linear accelerator conference; Darmstadt-Seeheim, F.R. Germany (7 May 1984).

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A source of high-intensity, single-bunch electron beams has been developed at SLAC for the SLC. The properties of these beams have been studied extensively utilizing the first 100-m of the SLAC linac and the computer-based control system being developed for the SLC. The source is described and the properties of the beams are summarized. 9 references, 2 figures, 1 table.

29109 **(SLAC-PUB—3324) High power rf klystrons for linear accelerators.** Konrad, G.T. (Stanford Linear Accelerator Center, CA (USA)). Apr 1984. Contract AC03-76SF00515. 6p. (CONF-840529—31). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE84012074.

From Linear accelerator conference; Darmstadt-Seeheim, F.R. Germany (7 May 1984).

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Recent klystron developments at SLAC are described. The standard 40 MW klyston, which typically operates at 35 MW on the SLAC linac, is the starting point for the push to higher peak and average power. The standard tube is capable of a 2.5 μs rf pulse width at 360 pps. For the SLC a 50 MW klystron capable of 5 μs pulse width at 180 pps is under development. Another tube currently being worked on is a 150 MW klystron capable of 1 μs rf and 180 pps. Design criteria and actual operating experience for both developmental tubes are described. 10 references, 11 figures, 3 tables.

29110 **Improved extraction of zirconium and molybdenum beams from a Penning discharge ion source.** Lewis, M.B. (Oak Ridge National Lab., TN). *Nuclear Instruments and Methods in Physics Research;* **219**: No. 1, 247-249(Jan-Feb 1984).

Letter-to-the-editor.

Modifications to a Penning discharge type ion source have made it possible to increase significantly the yield and lifetime of the refractory metal ion beams zirconium and molybdenum.

29111 **Dual aperture dipole magnet with second harmonic component.** Praeg, W.F. (to Dept. of Energy). US Patent Application 6-528,278. 31 Aug 1983. 17p. Contract W-31-109-ENG-38.

An improved dual aperture dipole electromagnet includes a second-harmonic frequency magnetic guide field winding which surrounds first harmonic frequency magnetic guide field windings associated with each aperture. The second harmonic winding and the first harmonic windings cooperate to produce resultant magnetic waveforms in the apertures which have extended acceleration and shortened reset portions of electromagnet operation.

4304 Storage Rings

REFER ALSO TO CITATION(S) 29075, 29585, 29586, 29609

29112 **(ANL-HEP-CP—84-16) Anti p-p collider group.** Collins, T.; Gelfand, N.; Johnson, D.; Walker, J.; Diebold, R.; Frisch, H. (Fermi National Accelerator Lab., Batavia, IL (USA); Argonne National Lab., IL (USA); Chicago Univ., IL (USA). Enrico Fermi Inst.). 1984. Contract W-31-109-ENG-38. 3p. (CONF-840275—6). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE84012102.

From Workshop on anti pp options for the SSC; Chicago, IL, USA (13 Feb 1984).

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While this small group was largely occupied in interacting with other groups, there are some conclusions of general interest. The anti p-p lattice and beam avoidance scheme for a single ring collider, as presented by T. Collins, was accepted as a proof-by-example that a collider could be built with a substantial luminosity. There were no suggestions for improvement, in fact the limitations of this design are not likely to be improved. A production rate of 10^9 anti p's/sec provides for a total luminosity of 3 x 10^{33} or 5 x 10^{32} in each of six interaction regions.

29113 **(DESY-L-Trans—286) Possibility for production of longitudinally polarized colliding beams at the collider VEPP-4 within the energy region of ypsilon-resonances.** Nikitin, S.A.; Saldin, E.L.; Yurkov, M.V. (Deutsches Elektronen-Synchrotron (DESY), Hamburg (Germany, F.R.)). Jan 1984. 39p. Deutsches Elektronen-Synchrotron (DESY), Hamburg (Germany, F.R.).

Translated from Russian. Published as preprint 81-116 AN SSSR, Novosibirsk. Inst. Yadernoj Fiziki.

A variant for low longitudinal polarization in the center of a magnetic detector with transversal magnetic field (MF) by means of superconducting solenoids arranged in straight sections at both sides of the MF was calculated. The perturbation, which was introduced into the orbital motion by solenoids and their depolarizing effect upon the spin is compensated due to a special selection of optics of the experimental section. Hereby we succeeded in reaching simultaneously the admissible equilibrium degree of longitudinal polarization and a bean focussing in the interaction point near the ordinary focussing. The depolarizing effect of errors of the magnetic system was calculated.

29114 **(DOE/ER/40089—1) Simulation of ultra-low emittance electron storage rings. Technical progress report.** Hand, L.N. (Cornell Univ., Ithaca, NY (USA). Dept. of Physics). 18 May 1984. Contract AC02-83ER40089. 22p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE84012050.

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In May 1983, shortly after the work in this area was begun, the principal investigator was invited to the Soviet Union as a guest of the USSR Academy of Sciences. During that visit a lecture on the future of high energy physics was delivered at three Institutes, two in Moscow and one in Novosibirsk. The overall future development of high energy physics was reviewed in the light of the then current extreme pessimism about achieving meaningful scientific results at energies an order of magnitude above those currently available. It was concluded by the author that there was little actual basis for pessimism but that considerable theoretical and experimental work needed to be done over the next 20 to 30 years to prevent a scientific crisis from occurring at that time. The need for more options and relatively straightforward nature of the extrapolation to large proton accelerators such as the SSC led the author to conclude that the alternative of a large (1 TeV) electron linear collider as a possible future option should be explored as well. The rest of this work, (which has been accepted for publication in Particle Accelerators) concentrated on the fundamental limitations which might prevent us from achieving such an accelerator, i.e., those limits which are of a general and fundamental character and are independent of additional limitations arising from a specific technology.

44 INSTRUMENTATION

4401 Radiation Instrumentation

REFER ALSO TO CITATION(S) 27994, 28258, 28373, 28374, 28375, 28376, 28377, 28378, 28379, 29101, 29245, 29396, 29589, 29603, 29693, 29694, 29796

29115 **(AD-A—136681/4) Shuttle flight test of an advanced gamma-ray detection system. Final scientific report 1 Oct 82-31 Mar 83.** Rester, A.C. Jr. (Florida Univ., Gainesville (USA). Space Astronomy Lab.). Nov 1983. 20p. NTIS, PC A02/MF A01.

The Stace Astronomy Laboratory plans to fly an advanced gamma-ray spectrometer aboard a future Shuttle flight. The 'GRAD' spectrometer employs a new bismuth germanate (BGO) anticompton shield and n-type high purity germanium detector. BGO, because of its high atomic number, requires only 1/12 the volume and 1/6 the weight of an equally sensitive sodium iodide crystal. The n-type germanium detector is at least 25 times more resistant to neutron radiation damage than a conventional detector and has a very broad spectral response of 5 keV to 10 MeV. Neither of these materials has been subjected to the space environment as working components of a detector system. The radioactivation of the new detector materials by cosmic rays and fast neutrons, as well as other effects of launching, landing and operation in the space environment on the detector system will be monitored and calibrated. Early information on gamma-ray background from activation of the shuttle itself will also be obtained. In addition to the technological information derived from the experiment, high energy-resolution spectra of the sun and the galactic center will be taken.

29116 **(AD-A—137496/6) Spectrum-averaged kerma factors for reactor dosimetry with paired ion chambers. Technical report.** Ferlic, K.P.; Zeman, G.H. (Armed Forces Radiobiology Research Inst., Bethesda, MD (USA)). Sep 1983. 32p. NTIS, PC A03/MF A01.

Neutron and gamma spectrum-averaged kerma factors (SAKF's) were calculated for four reference spectra and 18 configurations of the AFRRI TRIGA reactor for materials of interest in dosimetry applications. Reactor gamma SAKF ratios for tissue to carbon and for tissue to magnesium (ion chamber wall materials) gave average values + or - 2 standard deviations of 1.13 + or - 1% and 1.09 + or - 3%, respectively. For some reactor configurations, the gamma SAKF ratios were as much as 7.6% different from corresponding values for cobalt-60 gamma rays. Reactor neutron SAKF ratios for ICRU (International Commission on Radiation Units and Measurements) muscle to ion chamber gas materials were as follows: TE (tissue-equivalent) gas, 0.983 + or - 0.5% for all configurations; carbon dioxide, 9.8 + 10%; and argon, 71 + or - 27%. At depth in a phantom, the neutron SAKF for ICRU muscle differed substantially from the free-in-air value for the same reactor configuration. This finding suggests the need for more thorough spectrum determinations in anatomical phantoms and for more sophisticated dosimetric tools to better quantitate the dose deposition process.

29117 (ANL—83-100-Pt.2, pp 38-45) **Study of the counting stability and efficiencies of radon chamber counters.** Jiang, H.; Holtzman, R.B.; Markun, F. Mar 1984. NTIS, PC A09/MF A01. Order Number DE84008870. TI84008870

In Environmental Research Division annual report: Center for Human Radiobiology, July 1982-June 1983.

The counting stability and relative efficiencies of our radon chamber counters were tested under stringent conditions. Although the instruments are sensitive to changes in temperature, normal operation is not seriously affected. Nevertheless, periodic checks for stability and monitoring of room temperature are necessary. 3 references, 3 figures, 2 tables.

29118 **(BNL—34524) Silicon drift chambers: first results and optimum processing of signals.** Gatti, E.; Rehak, P.; Walton, J.T. (Politecnico di Milano (Italy). Ist. di Fisica; Brookhaven National Lab., Upton, NY (USA); Lawrence Berkeley Lab., CA (USA)). 1983. Contract AC02-76CH00016. 17p. (CONF-8311154—1). NTIS, PC A02; 3; GPO Dep. Order Number DE84010290.

From 3. European symposium on semiconductor detectors; Munich, F.R. Germany (14 Nov 1983).

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A Semiconductor Drift Chamber was produced and tested. The paper describes: (1) principle of the chamber operation; (2) the performance of the test chamber; and (3) the signal processing to obtain the best position resolution.

29119 **(CEA-CONF—6867) Diogene pictorial drift chamber.** Gosset, J. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France)). Jun 1983. 10p. (CONF-8306139—2). NTIS (US Sales Only), PC A02/MF A01. Order Number DE84750628.

From Time projection chamber workshop; Vancouver, Canada (23 Jun 1983).

A pictorial drift chamber, called DIOGENE, has been installed at Saturne in order to study central collisions of high energy heavy ions. It has been adapted from the JADE internal detector, with two major differences to be taken into account. First, the center-of-mass of these collisions is not identical to the laboratory reference frame. Second, the energy loss and the momentum ranges of the particles to be detected are different from the ones in JADE. It was also tried to keep the cost as small as possible, hence the choice of minimum size and minimum number of sensitive wires. Moreover the wire planes are shifted from the beam axis: this trick helps very much to quickly reject the bad tracks caused by the ambiguity of measuring drift distances (positive or negative) through times (always positive).

29120 **(CEA-CONF—6937) Neutron detection with converter-track detector systems.** Chambaudet, A.; Le Thanh, P. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France)). Sep 1983. 4p. (CONF-830969—12). NTIS (US Sales Only), PC A02/MF A01. Order Number DE84750610.

From 12. international conference on solid state nuclear track detectors; Acapulco, Mexico (4 Sep 1983).

In order to detect neutrons at low energy two systems, namely natural boron converter-LR 115 track detector and lithium tetraborate converter-LR 115 have been investigated. The two systems are calibrated with a thick natural U source in order to determine the detection efficiency for particles recorded in all directions. The two systems are then tested with several neutron sources recovering the energy range from thermal neutrons to neutrons of 5.5 MeV.

29121 **(CEA-CONF—6938) Automatic track countings.** Chambaudet, A.; Fellmann, D.; Rebetez, M.; Le Thanh, P. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France)). Sep 1983. 4p. (CONF-830969—13). NTIS (US Sales Only), PC A02/MF A01. Order Number DE84750611.

From 12. international conference on solid state nuclear track detectors; Acapulco, Mexico (4 Sep 1983).

For convenient utilization of track detectors, results must be obtained quickly, so automatic processes are usually employed. To this end two techniques are investigated: spark counter and quantimet system. The first one is appropriate for low densities (below 4000 tracks/cm^2); for densities between 4000 tracks/cm^2 and 2.2 10^5 tracks/cm^2 counting is performed with a Cambridge Quantimet 720; for higher densities, two different methods are described which take into account the overlapping of tracks.

29122 **(CEA-CONF—6939) Detection efficiency for α particles (1.25 MeV < E < 3.3 MeV) in a LR 115 spark counter.** Le Thanh, P.; Chambaudet, A. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France)). Sep 1983. 4p. (CONF-830969—11). NTIS (US Sales Only), PC A02/MF A01. Order Number DE84750609.

From 12. international conference on solid state nuclear track detectors; Acapulco, Mexico (4 Sep 1983).

In order to detect neutrons at an energy below 1.5 MeV, a track detector dosimeter has been investigated using a (n,α) converter. The counting is made by an improved spark counter. The detection efficiency for α particles with different energies is carefully examined for different thicknesses of the detector to determine the best conditions of utilization.

29123 **(EFI—582(69)-82) Efficiency of high-energy particle identification statistical methods.** Chilingaryan, A.A. (Erevanskij Fizicheskij Inst. (USSR)). 1982. 22p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE84701688.

An attempt is made to analyze the statistical methods of making decisions on the high-energy particle identification. The Bayesian approach is shown to provide the most complete account of the primary discriminative information between the particles of various tupes. It does not impose rigid requirements on the density form of the probability function and ensures the account of the a priori information as compared with the Neyman-Pearson approach, the mimimax technique and the heristic rules of the decision limits construction in the variant region of the specially chosen parameter. The methods based on the concept of the nearest neighbourhood are shown to be the most effective one among the local methods of the probability function density estimation. The probability distances between the training sample classes are suggested to make a decision on selecting the high-energy particle detector optimal parameters. The method proposed and the software constructed are tested on the problem of the cosmic radiation hadron identification by means of transition radiation detectors (the "PION" experiment).

29124 **(EGG—10282-2033) Use of personal, real time in-cabin dosimetry on space shuttle flights.** Angelo, J.A. Jr.; Madonna, R.G.; Quam, W.; Warren, J.; Dockter, M. (Air Force Technical Applications Center, Patrick AFB, FL (USA); EG and G, Inc., Goleta, CA (USA). Energy Measurements Group; Department of Energy, Las Vegas, NV (USA). Nevada Operations Office). 1984. Contract AC08-83NV10282. 6p. (CONF-840712—1). NTIS, PC A02/MF A01; GPO Dep. Order Number DE84006669.

From 21. IEEE annual conference on nuclear and space radiation effects; Colorado Springs, CO, USA (22 Jul 1984).

The use of real time dosimeters onboard the Space Shuttle is described. Data taken during STS-8 with a small gamma ray counter (HRM-III) and a neutron/proton dosimeter (the Pocket Rem Meter [PRM]) are presented. The data agree with NASA predictions for gamma ray background and neutron-proton dosage received for the STS-8 mission. 1 figure, 1 table.

29125 **(FERMILAB/TM—1248) Measurements of radiation quality factors using a recombination chamber.** Cossairt, J.D.; Grobe, D.W.; Gerardi, M.A. (Fermi National Accelerator Lab., Batavia, IL (USA)). Mar 1984. Contract AC02-76CH03000. 16p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE84012520.

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The recombination chamber technique has been described in a CERN report by Sullivan and Baarli. In this method, one uses the fact that a high pressure ion chamber operated at a voltage beneath its plateau will measure a greater response to radiation of low LET than to radiation of high LET in fields of equivalent absorbed dose rate. This report describes a calibration procedure and results obtained in accelerator radiation fields. 8 references, 6 figures. (ACR)

29126 (INIS-mf—8927, pp 69-75) **Personnel dosimetry.** Trousil, J.; Kokta, L. 1981. (In Russian). NTIS (US Sales Only), PC A05/MF A01. Order Number DE84780240. TI84780240

In 60 years of the Institute for Research, Production and Application of Radioisotopes 1919-1979.

The Personnel Dosimetry Laboratory is responsible for personnel dosimetry services country-wide, covering all workplaces handling radiation. High-risk personnel use photographic and thermoluminescence dosemeters in a single cartridge. For neutron dosimetry, fission foil detectors and silicon diodes are used. The dosimeters are evaluated each month. Low-risk personnel use photographic film dosemeters which will be replaced by thermoluminescence dosemeters; dielectric track detectors are used for neutron dosimetry. The dosemeters are evaluated once in three months. (M.D.).

29127 (INIS-SU—198, pp 369) **High-energy heavy ion spectrometer.** Semenov, Yu.V.; Smirnov, V.I. 1983. (In Russian). NTIS (US Sales Only), PC A99/MF A01. Order Number DE84780104. (CONF-8304144—Summ.). TI84780104

From 23. conference on nuclear spectroscopy and nuclear structure; Moscow, USSR (19 Apr 1983).

29128 (INIS-SU—198, pp 384) **Installation for measurement of photon energy spectra at the presence of strong electron background.** Ishkhanov, B.S.; Piskarev, I.M.; Sorvin, V.M.; Khamraev, F.Sh.; Arzibekov, U.R. 1983. (In Russian). NTIS (US Sales Only), PC A99/MF A01. Order Number DE84780104. (CONF-8304144—Summ.). TI84780104

From 23. conference on nuclear spectroscopy and nuclear structure; Moscow, USSR (19 Apr 1983).

29129 (INIS-SU—198, pp 386) **On-line system for gamma-spectroscopic investigations of nuclei and gypernuclei in a bremsstrahlung beam by the (meson-γ) coincidence method.** Eliseev, A.N.; Kashevarov, V.L.; Rzhanov, E.V.; Rylov, S.V.; Smirnov, P.A.; Sokol, G.A.; Fomenko, A.M. 1983. (In Russian). NTIS (US Sales Only), PC A99/MF A01. Order Number DE84780104. (CONF-8304144—Summ.). TI84780104

From 23. conference on nuclear spectroscopy and nuclear structure; Moscow, USSR (19 Apr 1983).

29130 (INIS-SU—198, pp 510) **Application of superhigh-purity germanium detector for precise measurements of threshold energies of continuous positron spectra.** Ganbaatar, N.; Lyatushinski, A.; Mezilev, K.A.; Novikov, Yu.N.; Potempa, A.; Tarkani, F.; Khvashchevska, Ya.; Yurkovski, Ya. 1983. (In Russian). NTIS (US Sales Only), PC A99/MF A01. Order Number DE84780104. (CONF-8304144—Summ.). TI84780104

From 23. conference on nuclear spectroscopy and nuclear structure; Moscow, USSR (19 Apr 1983).

29131 (INIS-SU—198, pp 366) **Realization of automatic measurements of nuclear reaction product angular distribution.** Kumshaev, S.B.; Ofengenden, R.G.; Svetlichnyj, P.N.; Urin, V.N.; Yasnogorodskij, A.M. 1983. (In Russian). NTIS (US Sales Only), PC A99/MF A01. Order Number DE84780104. (CONF-8304144—Summ.). TI84780104

From 23. conference on nuclear spectroscopy and nuclear structure; Moscow, USSR (19 Apr 1983).

29132 **(KFK—3638) Liquid ionization chamber using tetramethylsilane.** Engler, J.; Keim, H. (Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.). Inst. fuer Kernphysik). Dec 1983. 15p. (In German). NTIS (US Sales Only), PC A02/MF A01. Order Number DE84751347.

First results with a liquid ionization chamber using tetramethylsilane (TMS) are presented. A stack of iron plates was tested with cosmic ray muons and the charge output for minimum ionizing particles was measured.

29133 (LBL—16281, pp 87-90) **Active multitarget experiment for anomalons.** Enorini, M.; Fabbri, F.L.; Zallo, A. (Laboratori Nazionali di Frascati, Italy). Dec 1983. NTIS, PC A99/MF A01. Order Number DE84005862. (CONF-830675—). TI84005862

From 6. high energy heavy ion study and 2. workshop on anomalons; Berkeley, CA, USA (28 Jun 1983).

Anomalons are in fashion despite of their ancient first appearance in photographic emulsions exposed to cosmic rays. As matter of fact anomalons do not fit in any conventional picture of nuclear and particle physics. Until now anomalons have been studied in emulsions by exposures at cosmic rays or, more recently, at relativistic ion beams. This technique provides an excellent spatial resolution, but does not allow to clarify the behaviour of anomalous fragments in vacuum (or air) and is very poor in statistics and lacking in oriented triggers. Only the counter experiments technique can provide the necessary statistics and investigate if anomalons are spontaneously decaying. We propose to use subsequent active targets in order to trigger on reinteraction of produced fragments. The experimental method takes advantages from the peculiar feature of anomalons and from their enhanced cross section. The presence of anomalons among the fragments originates an over production of secondary interactions. Therefore triggering on successive interactions of the fragments is the best method to substantiate the existence of anomalons and to improve the selectivity of an experiment. The comparison of the rates of the secondary interactions is directly correlated with the fraction of anomalous fragments, their cross section and the "memory" effect. The use of silicon solid state detectors as active target, as well as, tracking and charge detectors for the emitted fragments is described.

29134 (LBL—16281, pp 91-94) **chi^2 analyses of nuclear emulsion anomalous projectile fragment data.** MacGregor, M.H. (Lawrence Livermore National Lab., CA). Dec 1983. NTIS, PC A99/MF A01. Order Number DE84005862. (CONF-830675—). TI84005862

From 6. high energy heavy ion study and 2. workshop on anomalons; Berkeley, CA, USA (28 Jun 1983).

Previously, chi^2 least-squares fits to emulsion data were used to demonstrate the existence of a Z-dependence in anomalous projectile fragment (APF) mean free paths (MFP's). This work is extended by (a) using some Z-separated data, and (b) applying various isotopic corrections to the "normal" beam projectile MFP's. With a combined Buffalo, LBL, Minnesota, NRC data base, the null hypothesis (no APF effect) is rejected by more than 7 standard deviations. 14 references.

29135 (PNL-SA—11719) **Large-volume ultralow background germanium-germanium coincidence/anticoincidence gamma-ray spectrometer.** Brodzinski, R.L.; Brown, D.P.; Evans, J.C. Jr.; Hensley, W.K.; Reeves, J.H.; Wogman, N.A.; Avignone, F.T. III; Miley, H.S.; Moore, R.S. (Pacific Northwest Lab., Richland, WA (USA); South Carolina Univ., Columbia (USA)). Mar 1984. Contract AC06-76RL01830. 10p. (CONF-840408—9). NTIS, PC A02/MF A01; GPO Dep. Order Number DE84010775.

From 5. international conference on nuclear methods in environmental and energy research; Mayaguez, Puerto Rico (2 Apr 1984).

A large volume (~ 1440 cm^3), multicrystal, high resolution intrinsic germanium gamma-ray spectrometer has been designed based on 3 generations of experiments. The background from construction materials used in standard commercial configurations has been reduced by at least two orders of magnitude. Data taken with a 132 cm^3 prototype detector, installed in the Homestake Gold Mine, are presented. The first application of the full scale detector will be an ultrasensitive search for neutrinoless and two-neutrino double beta decay of ^{76}Ge. The size and geometrical configuration of the crystals is chosen to optimize detection of double decay to the first excited state of ^{76}Se with subsequent emission of a 559 keV gamma ray. The detector will be sufficiently sensitive for measuring the neutrinoless double beta decay to the ground state to establish a minimum half life of 1.4.10^{24} y. Application of the large spectrometer system to the analysis of low level environmental and biological samples is discussed.

29136 (SLAC-PUB—3317) **New drift chamber for the Mark II at SLC.** Hanson, G.G. (Stanford Linear Accelerator Center, CA (USA)). Apr 1984. Contract AC03-76SF00515. 10p. (CONF-840396—4). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE84010882.

From International conference on instrumentation for colliding beam physics; Novosibirsk, USSR (15 Mar 1984).

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A new cylindrical drift chamber is being constructed for the Mark II detector for use at the new SLAC Linear Collider. The design of the new chamber is based on a multi-sense-wire cell of the jet-chamber type. In addition to drift-time measurements, pulse height measurements from the sense wires will provide electron-hadron separation by dE/dx. The design and construction of the chamber, tests of prototypes, and chamber electronics are discussed. 7 references, 12 figures.

29137 (UCID—20059) **Radiochemical detector cross section sensitivity studies in the A ≅ 90 mass region.** MacGregor, M.H. (Lawrence Livermore National Lab., CA (USA)). 5 Apr 1984. Contract W-7405-ENG-48. 46p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE84010954.

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The use of radiochemical detectors in the A ≅ 90 mass region to measure 14 MeV neutron fluences is investigated from the standpoint of cross section sensitivities. Specifically, ^{90}Zr and ^{89}Y neutron-induced cascades leading to the production of ^{89}Zr, ^{88}Zr, ^{88}Y, and ^{87}Y are studied in a one-energy-group approximation, and the sensitivities of the measured ratios R/sub Z/ = ^{88}Zr/^{90}Zr and R/sub Y/ = ^{87}Y/^{88}Y to the input cross sections are delineated. The most sensitive cross section in each cascade is the cross section that dominates the production of the final isotope in the chain. Only one of the isomeric levels in ^{90}Zr contributes importantly to the Zr cascade. Burnback (n,γ) and burnup (n,p) reactions are also considered. The (n,γ) effects are small, but (n,p) effects can be substantial due to low energy enhancements of (n,p) cross sections in the neutron-deficient isotopes.

29138 **Electrostatic precipitator for the study of airborne radioactivity.** Andrews, L.L.; Schery, S.D.; Wilkening, M.H. (New Mexico Inst. of Mining and Tech., Socorro). *Health Physics;* **46**: No. 4, 801-808(Apr 1984).

An system has been developed to measure airborne radioactivity using electrostatic precipitation for collection and α-particle spectroscopy for detection. Features include good energy resolution and versatile computer control for collection, counting and data reduction. Aerosols bearing the radioactive atoms are deposited on a foil tape by electrostatic precipitation for a predetermined time after which the foil is moved under a solid-state detector to count the α-particle emissions. Activities are determined at the same frequency as samples are collected. Helium gas can be introduced at the detector to reduce energy loss and improve resolution. Although in principle certain aerosol sizes could be difficult to collect, in practice no difficulties were observed for typical environmental conditions, provided sufficiently low air-sampling rates were used. One important application is the measurement of ^{222}Rn daughters.

29139 **Passive, integrated measurement of indoor radon using activated carbon.** George, A.C. (Department of Energy, New York, NY). *Health Physics;* **46**: No. 4, 867-872(Apr 1984).

Activated carbon canisters were tested to determine their adsorption and retention characteristics for radon. These tests conducted indoors under typical conditions of temperature and relative humidity indicate that simple, inexpensive and maintenance-free passive devices containing 150-200 g of activated carbon can measure radon conveniently and adequately. The amount of radon absorbed in the collector is determined by counting the γ rays from the decay products of radon. The lower limit of detection for radon is 0.2 pCi/1 for an exposure of 72 hr. Tests in a residential building and in a test chamber indicate that the measured radon in the canister is proportional to the mean concentration of radon during the

period of exposure when correction for relative humidity is made. For practical situations encountered indoors, the device yields results accurate to within +/- 20%.

29140 **Bismuth germanate's role in the new revolution in gamma-ray spectroscopy.** Johnson, N.R.; Baktash, C.; Lee, I.Y. (Oak Ridge National Laboratory, Oak Ridge, Tennessee 37830). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Nuclear Science;* **31**: No. 1, 243-248(Feb 1984). (CONF-831015—). Contract W-7405-ENG-26.

From Nuclear science symposium; San Francisco, CA, USA (19 Oct 1983).

This paper begins by reviewing the history of gamma-ray spectroscopy and then discusses some of the recent results based on data taken with coincidence arrays of germanium detectors and Compton-suppression spectrometers. It then addresses the first impacts which the use of bismuth germanate (BGO) detectors are having on the understanding of the properties of nuclei excited into states of high energy and very high angular momentum. BGO uses in this area are presently in their infancy; it is clear, however, that the utilization of such detectors, with their considerable gamma-ray stopping power, will play a major role in unraveling many of the mysteries of the nucleus in these extreme conditions. This paper covers some of the considerations involved in how to effectively incorporate BGO into complex detection systems, discusses some of the systems presently in operation or under construction, and stresses the new physics to be learned by utilizing these detector arrays.

29141 **The design of the data acquisition system for a very large bismuth germanate calorimeter.** Bakken, J.; Isaila, M.; Piroue, P.; Stickland, D.; Sumner, R. (Princeton University, Dept. of Physics, Joseph Henry Laboratories, P.O. Box 708, Princeton, NJ 08544). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Nuclear Science;* **31**: No. 1, 180-183(Feb 1984). (CONF-831015—).

From Nuclear science symposium; San Francisco, CA, USA (19 Oct 1983).

LEPC, the Large Electron Positron Collider being built at CERN, will be ready for experiments in 1988. A large array of bismuth germanate crystals will be part of one of the first experiments to be installed. Particles (including photons) resulting from the collisions will be identified and measured in the surrounding detector. At the center of this composite detector is a tracking device to observe the trajectories of all particles. Beyond this is the bismuth germanate array; it will measure the energy of electrons and photons from a few MeV to 100 GeV. This is surrounded by the hadron calorimeter. The bismuth germanate calorimeter will consist of about 12,000 individual bismuth germanate crystals. Each crystal will have an independent readout system. This system uses silicon photodiodes, each with its own ADC, to measure the scintillation light from each crystal. The ADC is implemented in software in a single chip microcomputer, using a modification of successive approximation, which produces a very wide dynamic range. The microcomputer also provides data buffering and several other housekeeping functions. The initial design of the readout system, presented in this paper, evolved from an attempt to minimize the size requirements and the number of cables needed, and to meet the dynamic range requirement in a practical way.

29142 **Bismuth germanate (bgo) optimisation for energy resolution and purity.** Barnes, R.G.L.; Rousseau, M.D.; Sims, R.; Sproston, M. (Johnson Matthey Chemicals Ltd., Orchard Road, Royston, Herts). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Nuclear Science;* **31**: No. 1, 249-252(Feb 1984). (CONF-831015—).

From Nuclear science symposium; San Francisco, CA, USA (19 Oct 1983).

Investigations are described which are being carried out into quality criteria for polycrystalline BGO for the production of crystals to be used in large high energy physics calorimeters. The objective is the definition of a material specification which can ensure that the bars are of high quality and reproducibility and have been manufactured in the most cost effective manner. Results are presented on the effect of selected impurities on the performance of bars made from materials of controlled composition.

29143 **Beam polarization at the ZGS.** Spinka, H.; Colton, E.; Ditzler, W.R.; Halpern, H.; Imai, K.; Stanek, R.; Tamura, N.; Theodosiou, G.; Toshioka, K.; Underwood, D. (Argonne National Lab., IL (USA)). *Nuclear Instruments and Methods in Physics Research;* **211**: No. 2/3, 239-261(15 Jun 1983).

With 93 refs.

A description is given of a beam polarimeter constructed for use at the Argonne ZGS and later at LAMPF. Details of the absolute calibration of these polarimeters are described. Conclusions for the absolute beam polarization at the ZGS impact a number of past polarized beam experiments, causing normalization changes in some cases of 8-25%. The normalization of some past pp polarization measurements are also affected by these results.

29144 **Real-time neutron beam monitor.** Becker, J.A. (California Univ., Livermore (USA). Lawrence Livermore National Lab.). *Nuclear Instruments and Methods in Physics Research;* **211**: No. 2/3, 297-300(15 Jun 1983).

An array of multiwire proportional counters has been employed to image, in 'real-time', a collimated neutron beam produced at an electron linac facility. Test results are presented, along with a discussion of the advantages of this technique.

29145 **Proposal for a semiconductor high resolution tracking detector.** Rehak, P. (Brookhaven National Lab., Upton, NY (USA)). *Nuclear Instruments and Methods in Physics Research;* **211**: No. 2/3, 323-329(15 Jun 1983).

A 'new' concept for detection and tracking of charged particles in high energy physics experiments is proposed. It combines a well known high purity semiconductor diode detector (HPSDD) with a heterojunction structure (HJ) and a negative electron affinity (NEA) surface. The detector should be capable of providing a two dimensional view (few cm^2) of multi-track events with the following properties: a) position resolution down to a few μm (10^8 position elements); b) high density of information (10^2-10^3 dots per mm of minimum ionizing track); c) high rate capabilities (few MHz); d) live operation with options to be triggered and/or the information from the detector can be used as an input for the decision to record an event.

4402 Radiation Effects On Instrument Components, Instruments, Or Electronic Systems

REFER ALSO TO CITATION(S) 28375, 28377, 28378, 28379

29146 **(AD-A—136957/8) Microdosimetric measurements on nuclear reactions. Final technical report.** McNulty, P.J. (Clarkson Coll. of Tech., Potsdam, NY (USA). Dept. of Physics). 1983. 150p. NTIS, PC A07/MF A01.

The major effort was to develop a computer simulation model of nuclear interactions induced by energetic protons. Our analysis indicates that the recoiling nuclear fragment is the dominant contributor to large energy depositions in small volume elements. This knowledge may allow considerable simplification in calculating proton induced error rates. Included in this report is Appendix A: Proton Induced Nuclear Reactions in Silicon, Appendix B: Charged Particles Cause Microelectronics Malfunction in Space and Appendix C: Energy Deposition by Nuclear Interactions in Microscopic Volumes.

29147 **(CEA-CONF—6956) Radiation effects in semiconductors: technologies for hardened integrated circuits.** Charlot, J.M. (CEA Centre d'Etudes de Bruyeres-le-Chatel, 92 - Montrouge (France)). Sep 1983. 21p. (CONF-8309203—1). NTIS (US Sales Only), PC A02/MF A01. Order Number DE84750614.

From 13. European solid state device research conference and 8. symposium on solid state device technology (ESSDERC 83); Canterbury, UK (13 Sep 1983).

Various technologies are used to manufacture integrated circuits for electronic systems. But for specific applications, including those with radiation environment, it is necessary to choose an appropriate technologie or to improve a specific one in order to reach

a definite hardening level. The aim of this paper is to present the main effects induced by radiation (neutrons and gamma rays) into the basic semiconductor devices, to explain some physical degradation mechanisms and to propose solutions for hardened integrated circuit fabrication. The analysis involves essentially the monolithic structure of the integrated circuits and the isolation technology of active elements. In conclusion, the advantages of EPIC and SOS technologies are described and the potentialities of new technologies (GaAs and SOI) are presented.

29148 **(CEA-CONF—6957) N and P MOS on sapphire transistors irradiated at very high radiation doses versus gate bias during irradiation.** Leray, J.L. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France)). Sep 1983. 3p. (CONF-8309203—2). NTIS (US Sales Only), PC A02/MF A01. Order Number DE84750615.

From 13. European solid state device research conference and 8. symposium on solid state device technology (ESSDERC 83); Canterbury, UK (13 Sep 1983).

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The aim of the paper is to show the influence of gate biasing on Qox and Nss build-up at various levels of irradiation. Qox and Nss behaviour is found to be different.

29149 **(SAND—84-0525C) Irradiation of optimized, MBE grown, AlGaAs/GaAs radiation hardened photodiode.** Wiczer, J.J.; Fischer, T.A.; Dawson, L.R.; Osbourn, G.C.; Zipperian, T.E.; Barnes, C.E. (Sandia National Labs., Albuquerque, NM (USA)). Mar 1984. Contract AC04-76DP00789. 5p. (CONF-840712—2). NTIS, PC A02/MF A01; GPO Dep. Order Number DE84008034.

From 21. IEEE annual conference on nuclear and space radiation effects; Colorado Springs, CO, USA (22 Jul 1984).

An AlGaAs/GaAs double heterojunction photodiode structure designed to be less susceptible to the disrupting effects of ionizing-radiation pulses was fabricated and tested. We report here an optimized structure, fabricated with the molecular beam epitaxy process for improved electrical and optical properties. We also report additional pulsed ionzing-radiation testing, including: irradiations with an 18 MeV electron beam from a linear accelerator, exposures to 1 to 10 MeV x-ray from the Hermes machine, and simultaneous neutron and gamma exposure from the SPR-III pulsed reactor.

29150 **(SAND—84-0771) Radiation effects in optoelectronic devices.** Barnes, C.E.; Wiczer, J.J. (Sandia National Labs., Albuquerque, NM (USA)). May 1984. Contract AC04-76DP00789. 348p. NTIS, PC A15/MF A01; 1; GPO Dep. Order Number DE84012889.

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Purpose of this report is to provide not only a summary of radiation damage studies at Sandia National Laboratories, but also of those in the literature on the components of optoelectronic systems: light emitting diodes (LEDs), laser diodes, photodetectors, optical fibers, and optical isolators. This review of radiation damage in optoelectronic components is structured according to device type. In each section, a brief discussion of those device properties relevant to radiation effects is given.

29151 **(SLAC-PUB—3339) Performance of BGO in a high radiation environment.** Bobbink, G.J.; Engler, A.; Kraemer, R.W.; Nash, J.; Sutton, R.B.; Gearhart, R.A.; Linde, F.L.; Sens, J.C. (Carnegie-Mellon Univ., Pittsburgh, PA (USA). Dept. of Physics; Stanford Linear Accelerator Center, CA (USA)). May 1984. Contract AC03-76SF00515;AC02-76ER03066. 5p. (CONF-840396—5). NTIS, PC A02/MF A01; GPO Dep. Order Number DE84012273.

From International conference on instrumentation for colliding beam physics; Novosibirsk, USSR (15 Mar 1984).

Bismuth Germanate ($Bi_4Ge_3O_{12}$), an inert, high Z, and non-hygroscopic material, with a short radiation length L/sub RAD/ = 1.1 cm, has been proposed as the scintillator in a 4π electromagnetic calorimeter at LEP. Recently long BGO crystals have become available and studies of the effect of radiation have been made by several groups. We report here on the decrease of the light output of long BGO crystals due to irradiation by ^{60}Co γ-rays and 25 MeV electrons with doses from 50 to 5000 rad and on the performance of a 4 x 4 matrix of BGO crystals located at small angles (5 to 9 mrad, a high radiation environment) at the e^+e^- storage ring PEP at SLAC. All crystals used are 2 x 2 x 23 or 2 x 2 x 24 cm^3, have all six faces polished, and are wrapped in white teflon tape. 9 references, 11 figures.

4403 Miscellaneous Instruments

REFER ALSO TO CITATION(S) 28875, 28883

29152 **(DOE/NV/10282—4066) Development of long-length wire-filament strain gages.** Reid, D.E.; Cordill, C.A. (EG and G, Inc., San Ramon, CA (USA). Energy Measurements Group; Lawrence Livermore National Lab., CA (USA)). 1984. Contract AC08-83NV10282. 9p. (CONF-840577—6). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE84011543.

From 30. international instrumentation symposium; Denver, CO, USA (7 May 1984).

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To ensure the integrity of an epoxy/sand/gravel plug for an underground explosion, a need arose to develop an extra-long wire-filament strain gage. Extra-long gages were required because it was important to known the strain level of the entire plug and commercial gages were typically less than 6 in. long. The extra-long gages were designed and fabricated with lengths of between 1 and 10 ft; they weighted between 2 and 25 lb. The gages were fabricated by wrapping a fine filament wire onto a structural skeleton which was potted into a mold using the same epoxy/sand/gravel mixture as the plug. This resulted in a gage package that could be emplaced before the bulk of the plug was poured. Gages were built with both temperature-compensating dummy legs and active Poisson legs included in the package.

29153 (INIS-mf—8921, pp 52) **Alignment and fabrication errors in optical systems.** Eisenberg, S. (Ministry of Defence, Tel Aviv (Israel)). 1983. NTIS (US Sales Only), PC A05/MF A01. Order Number DE84780235. (CONF-8303128—Summ.). TI84780235

From Israel Physical Society annual meeting; Ramat-Gan, Israel (24 Mar 1983).

29154 (INP—1080/PL, pp 154-159) **Spin generators and measurement of weak magnetic fields.** Jesmanowicz, A.; Gutsze, A. (Uniwersytet Mikolaja Kopernika, Torun (Poland). Inst. Fizyki). 1980. (In Polish). NTIS (US Sales Only), PC A13/MF A01. Order Number DE84780233. (CONF-791295—). TI84780233

From 12. national seminar on nuclear magnetic resonance and its applications; Cracow, Poland (3 Dec 1979).

Spin operators used for stabilization of resonance requirements in NMR spectrometer of high resolution are described. The rules of their performance are given. Their schemes are presented.

29155 **(SAND—83-8043) Thermocouple simulation: a calibration technique.** Klevgard, P.A. (Sandia National Labs., Livermore, CA (USA)). May 1984. Contract AC04-76DR00789. 20p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE84012408.

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Many calibration laboratories are faced with the task of certifying temperature-readout devices that employ a thermocouple probe. This is best accomplished if a thermocouple junction's voltage output can be simulated at different temperatures and sent to the readout device. With equipment usually found in an electrical calibration laboratory, a suitable computer-controlled system can be constructed to simulate a given thermocouple junction for any selected temperature.

29156 **(UCRL—15582) Real-time measurements and control of particle charge as applied to electrostatically enhanced fabric filters. Technical progress report.** Mazumder, M.K.; Ballard, G.S.; Rimmer, T.W.; Cramer, D.M.; Young, P.L. (Arkansas Univ., Little Rock (USA). Dept. of Electronics and Instrumentation). Aug 1983. Contract W-7405-ENG-48. 26p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE84011055.

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The charge and size distribution of particles and the electric field on a filter medium play important roles in increasing particulate collection efficiency, decreasing the filter resistance coefficient and improving filter cleanability of electrostatically enhanced fabric filters (ESFF). To determine quantitatively the effect of the particle's electrical mobility on the performance of an ESFF, it is necessary to perform laboratry experiments on test aerosols where both particle charge and size distribution are varied with an applied electrical field across the filter medium.

29157 **Circular dichroism microspectrophotometer.** Maestre, M.F.; Katz, J.E. (Lawrence Berkeley Lab., CA). *Biopolymers;* **21**: 1899-1908(1982). Contract W-7405-ENG-48.

A microscope capable of measuring the CD of intact single eukaryotic cells, DNA microcrystals, and other microscopic structures has been constructed and tested. It can measure the CD spectra in the 200- and 800-nm wavelength range and consists of a modification to a standard Cary 60 CD machine in combination with a Zeiss uv microspectrometer. Preliminary CD spectra of red blood cells and lymphocytes are presented.

4404 Well Logging Instrumentation

REFER ALSO TO CITATION(S) 29161

45 EXPLOSIONS AND EXPLOSIVES

4501 Chemical

29158 **(AD-A—136816/6) Analysis plan for 1985 large-scale tests. Technical report.** McMullan, F.W. (Kaman Tempo, Albuquerque, NM (USA)). 1 Jan 1983. 54p. NTIS, PC A04/MF A01.

The purpose of this effort is to assist DNA in planning for large-scale (upwards of 5000 tons) detonations of conventional explosives in the 1985 and beyond time frame. Primary research objectives were to investigate potential means to increase blast duration and peak pressures. This report identifies and analyzes several candidate explosives. It examines several charge designs and identifies advantages and disadvantages of each. Other factors including terrain and multiburst techniques are addressed as are test site considerations.

29159 **(KTECH-TR—80-01-Vol.2) Shock characterization of explosive materials. Volume 2. 5-cyanotetrazolatopentaamine-cobalt(III) perchlorate (CP). Final report.** Lee, L.M.; Jenrette, B.D. (Ktech Corp., Albuquerque, NM (USA)). May 1980. Contract AI04-81AL16265. 33p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE84012282.

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The results of an experimental program to generate dynamic mechanical properties data for an unreacted porous explosive material are discussed and the data presented. Stress-particle velocity Hugoniot data were experimentally determined for 5-cyanotetrazolatopentaamine-cobalt(III) perchlorate (CP) using flat plate impact techniques. The CP samples were fabricated to the desired bulk sample density and size using a pressing technique. Samples with nominal densities of 1.47 and 1.66 g/cm^3 were investigated. The Hugoniot data for both sample densities showed essentially the same compaction behavior at stress levels above 5 kbar. The stress-time data showed major stress increases following impact, indicating initiation of a lower order chemical reaction. A constant high amplitude stress plateau was achieved after impact in a number of the experiments. These data provide both shock initiation and reaction rate information for CP.

29160 **(KTECH-TR—81-12-Vol.1) Shock sensitivity of 2-(5-cyanotetrazolato) pentaamine cobalt(III) perchlorate. Final report.** Fogelson, D.J. (Ktech Corp., Albuquerque, NM (USA)). Nov 1981. Contract AI04-81AL16265. 40p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE84012203.

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CP shock sensitivity threshold tests has been conducted with flyer velocities above 1.0 mm/μs and all the samples had detonated. The energy source to explode the foil was a capacitor discharge unit. Flyer thickness was varied. Impact tests were conducted in air and vacuum. Tests were also conducted with flyers of different area. A steel dent block was used to position the explosive sample, which was pressed into a steel ring, and verify detonation. Diagnostic tests were performed with a streak camera.

29161 **(PB—84-148485) Microexplosions in boreholes (mikroexplosioner i borrhael).** (Foersvarets Forskningsanstalt, Sundbyberg (Sweden)). Dec 1983. 19p. (FOA-C—20523-E1). NTIS, PC E03/MF E01.

At present microexplosions are the only known source that provides sufficient energy for large scale (about 0.5-1 km) seismic cross-hole measurements. This report summarizes results from a test of 'non-destructiveness' on bore-hole walls from microexplosions. From geophysical well loggings in the holes it was found that only microexplosions with yields of 100 g and greater have a measurable effect on the bore-hole walls. However,the chemical properties of the bore-hole water changed as a result of collodial carbon of the explosive paste. Geophone-recordings from a series of shots with yields in the range 5 up to 200 g showed that the recorded maximum amplitude was linearly dependent of explosion yield.

29162 **(SAND—83-2168) Spectra of visible emission from detonating PETN and PBX 9407.** Renlund, A.M.; Trott, W.M. (Sandia National Labs., Albuquerque, NM (USA)). Feb 1984. Contract AC04-76DP00789. 29p. NTIS, PC A03/MF A01; GPO Dep. Order Number DE84011128.

Spectra of the visible emission from detonating PETN and PBX 9407 have been obtained and clearly show CN ($B^2\Sigma^+$)), CH($A^2\Delta$), C_2 (d^3/PI//sub g/) and $NO_2(A^2B_2)$ as emitting species. Relative vibrational level populations in CN(B) and C_2(d) were measured from the intensity of their well-resolved vibronic bands in the PETN detonations. These results were used to calculate Boltzmann vibrational temperatures of 3300 +- 300 K and 4100 +- 800 K for CN(B) and C_2(d), respectively. These may be lower limits to the actual detonation temperature.

29163 **(UCID—20081) Determination of polysaccharides in TATB.** Stephens, F.B. (Lawrence Livermore National Lab., CA (USA)). May 1984. Contract W-7405-ENG-48. 6p. NTIS, PC A02/MF A01; GPO Dep. Order Number DE84012872.

This report describes an analytical method for determining residual polysaccharide in triamino-trinitro-benzene (TATB). In the method, the absorbance of a color developed by the complex formed between polysaccharide and Anthrone reagent in 3:1 H_2SO_4 is measured at 625 nm.

29164 **Method of making fine-grained triaminotrinitrobenzene.** Benziger, T.M. US Patent Application 6-517,531. 26 Jul 1983. 8p. Contract W-7405-ENG-36.

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A method is given for forming a fine-grained species of the insensitive high explosive sym-triaminotrinitrobenzene (TATB) without grinding. In accordance with the method, 1,3,5-trichloro-2,4,6-trinitrobenzene (TCTNB) is aminated by reaction with gaseous ammonia in an emulsion of toluene in water. The ratio of water to toluene in the emulsion is selected so that toluene is the dispersed phase in the emulsion. The size of the dispersed TCTNB-containing toluene droplets determines the particle size of the resulting TATB. The emulsion is preferably formed with an emulsifier such as ammonium oleate, which may be generated in situ from oleic acid, and stabilized with a protective colloid such as polyvinyl alcohol.

29165 **Barrier breaching device.** Honodel, C.A. (to Dept. of Energy). US Patent Application 6-500,112. 1 Jun 1983. 9p. Contract W-7405-ENG-48.

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A barrier breaching device that is designed primarily for opening holes in interior walls of buildings uses detonating fuse for explosive force. The fuse acts as the ribs or spokes of an umbrella-like device that may be opened up to form a cone. The cone is placed against the wall so that detonating fuse that rings the base of the device and which is ignited by the spoke-like fuses serves to cut a circular hole in the wall.

29166 **Application of neutron radiation inspection at the Pantex Plant.** Cassidy, J.P. (Mason and Hanger-Silas Mason Co., Inc., Amarillo, TX (USA)). pp 707-716 of Neutron radiography. Proceedings of the first world conference San Diego, California, USA, December 7-10, 1981. Barton, J.P. (Neutron Radiography Consulting, La Jolla, CA (USA)); Hardt, P. von der (Commission of the European Communities, Petten (Netherlands). Joint Nuclear Research Center) (eds.). Dordrecht, Netherlands; D. Reidel (1983). (CONF-811215—).

From 1. world conference on neutron radiography; San Diego, CA, USA (7 Dec 1981).

Includes author index.

A neutron radiographic capability has been established at the Pantex Plant in Amarillo, Texas, which is operated for the Department of Energy by Mason and Hanger-Silas Mason Co. A 3 MeV Van de Graaf accelerator is employed as the neutron source. Neutron radiation inspection techniques have been developed to detect and observe discontinuities in explosive materials encased in aluminum, lead, steel and combinations of these casement materials. These data demonstrate that the capability exists for obtaining satisfactory neutron radiographs of many explosive-loaded components. Additional work will be performed in order to further determine applicable capabilities of the 3 MeV Van de Graaf accelerator.

4502 Nuclear

REFER ALSO TO CITATION(S) 29271

29167 **(AD-A—136818/2) Reference manual, background materials for the conus volumes.** Rohrer, S.; Wilkinson, M. (JRB Associates, Inc., McLean, VA (USA)). 25 Apr 1983. 224p. NTIS, PC A10/MF A01.

This report provides supplementary information to the series and shot volumes. The information includes a glossary; list of acronyms; explanations of radiation health concepts, radiation measurement, radiation detection, radiation protection, and radiation standards; and a list of data and document sources.

29168 **(AD-A—136819/0) Operation hardtack I-1958. Technical report.** Gladeck, F.R.; Gould, K.G.; Hallowell, J.H.; Martin, E.J.; McMullan, F.W. (Kaman Tempo, Santa Barbara, CA (USA)). 1 Dec 1982. 474p. NTIS, PC A20/MF A01.

HARDTACK I was an atmospheric nuclear weapon test series held at Johnston Island and in the Marshall Islands at Enewetak and Bikini atolls in 1958. This is a report of DOD personnel in HARDTACK with an emphasis on operations and radiological safety.

29169 **(AD-A—136820/8) Operation dominic I-1962. Technical report.** Berkhouse, L.; Davis, S.E.; Gladeck, F.R.; Hallowell, J.H.; Jones, C.B. (Kaman Tempo, Santa Barbara, CA (USA)). 1 Feb 1983. 436p. NTIS, PC A19/MF A01.

DOMINIC I was an atmospheric nuclear weapons test series conducted in the Pacific Ocean area in 1962. It included 5 high-altitude shots at Johnston Island, 29 airdrop airburst events near Johnston and Christmas Islands, one Polaris-launched airburst in the Christmas Island area, and one underwater test in the Pacific Ocean off the United States West Coast. This is a report on DOD personnel with an emphasis on operations and radiological safety.

29170 **(AD-A—136977/6) Nuclear weapon accident exercise 1983 (NUWAX-83) after action report. Volume 1.** (Defense Nuclear Agency, Washington, DC (USA)). 17 Oct 1983. 70p. NTIS, PC A04/MF A01.

A joint Department of Defense, Department of Energy (DOE), and Federal Emergency Management Agency (FEMA) Nuclear Weapon Accident Exercise, NUWAX-83, was conducted during the period 5-10 May 1983. Exercise participants included the United States Navy, DoE, FEMA, and the Commonwealth of Virginia (COV) as the major participating players. MUWAX-83 was the third such full-scale exercise of the nuclear weapon accident response capabilities and was conducted at the Department of Energy's Nevada Test Site (NTS). The scenario had artificialities specifically incorporated to provide maximum play for the widest possible variety of participants. In actual nuclear weapon transport, the United States employs stringent safety requirements in order to prevent aircraft accidents, such as portrayed in the MUWAX-83 scenario. Volume I contains an exercise overview and those lessons learned which were observed by the Exercise Joint Task Group.

29171 **(AD-A—137083/2) Body and surface wave modeling of observed seismic events. Final report 1 May-31 Oct 82.** Harkrider, D.G.; Helmberger, D.V. (California Inst. of Tech., Pasadena (USA). Seismological Lab.). 31 Oct 1982. 113p. NTIS, PC A06/MF A01.

Contents: A Generalized Reflection - Transmission Coefficient Matrix and Discrete Wavenumber Method for Synthetic Seismograms; Body Wave Amplitude and Travel Time Correlations across North America; and Evidence of Tectonic Release from Underground Nuclear Explosions in Long-period P-waves.

29172 **(LA-UR—84-1726) Little Boy replication: justification and construction.** Malenfant, R.E. (Los Alamos National Lab., NM (USA)). 1984. Contract W-7405-ENG-36. 5p. (CONF-840627—2). NTIS, PC A02/MF A01; GPO Dep. Order Number DE84012578.

From 29. annual meeting of the Health Physics Society; New Orleans, LA, USA (3 Jun 1984).

A reconstruction of the Little Boy weapon allowed experiments to evaluate yield, leakage measurements for comparison with calculations, and phenomenological measurements to evaluate various in-situ dosimeters. The reconstructed weapon was operated at sustained delayed critical at the Los Alamos Critical Assembly Facility. The present experiments provide a wealth of information to benchmark calculations and demonstrate that the 1965 measurements on the Ichiban assembly (a spherical mockup of Little Boy) were in error. 5 references, 2 figures.

50 ENVIRONMENTAL SCIENCES, ATMOSPHERIC

REFER ALSO TO CITATION(S) 30094

5001 Basic Studies

REFER ALSO TO CITATION(S) 28624, 29202, 29209, 29243

29173 **(ANL—82-65-Pt.4) Radiological and Environmental Research Division annual report, January-December 1982. Atmospheric physics. Part 4.** (Argonne National Lab., IL (USA)). Jan 1984. Contract W-31-109-ENG-38. 75p. NTIS, PC A04/MF A01; 1; GPO Dep. Order Number DE84009129.

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The first article in this report, although dealing with simple terrain, summarizes an effort to obtain measures of parameters important in transport and diffusion in the lower atmosphere solely by use of a Doppler acoustic sounding system. The second article describes participation in a multiagency experiment (Shoreline Environment Atmospheric Dispersion Experiment, SEADEX) to study the fate of materials released over a surface with notable surface nonuniformities, specifically at a coastal nuclear power plant during

onshore flow conditions. The third and fourth articles in this report address research on the local behavior of pollutants emitted from diesel engines in urban areas. Most effort was directed toward field studies on circulation patterns in street canyons, exchange rates with the atmosphere above rooftops, and characterization of particles in outdoor urban microclimates. The remainder of the report is quite diverse and contains multiple articles on perhaps only one or two types of research. One is numerical modeling of the behavior of atmospheric pollutants, especially gaseous and particulate substances associated with acid deposition. The modeling and theoretical capabilities have been developed in part to consider potential nonlinear relationships between anthropogenic emissions of sulfur and nitrogen compounds and the distant deposition of resulting acidifying substances. On the experimental side, field phases of research designed to compare methods of analyses of precipitation samples and to study local urban effects on precipitation chemistry were completed. Each report is indexed separately.

29174 (ANL—82-65-Pt.4, pp 1-6) **VOICE experiment: preliminary results.** Coulter, R.L.; Martin, T.J.; Underwood, K.H. Jan 1984. NTIS, PC A04/MF A01. Order Number DE84009129. TI84009129

In Radiological and Environmental Research Division annual report, January-December 1982. Atmospheric physics. Part 4.

The Vertical Observations Including Convective Exchange (VOICE) experiment was conducted from 18 June 1982 to 30 June 1982 in conjunction with the Dry Deposition Intercomparison Experiment (DDIE). The purpose of the experiment was to make detailed observations of the convective vertical velocity field of the planetary boundary layer (PBL) with the Doppler sodar. The DDIE provided measurements of such crucial surface-layer-boundary conditions as heat, momentum and water vapor fluxes, radiation balances, and surface-layer winds and temperatures. Additional activities for VOICE included monitoring of clouds through use of a time-lapse camera and making simultaneous double-theodolite observations to determine the mixing condensation level, cloud height, and cloud position during times propitious for the measurement of near-cloud velocities. 5 references, 4 figures.

29175 (ANL—82-65-Pt.4, pp 7-11) **SEADEX experiment.** Coulter, R.L.; Hart, R.L.; Martin, T.J.; Underwood, K.H.; Zerbe, G.A. Jan 1984. NTIS, PC A04/MF A01. Order Number DE84009129. TI84009129

In Radiological and Environmental Research Division annual report, January-December 1982. Atmospheric physics. Part 4.

Mesoscale atmospheric circulations created by sharp temperature differences at land-water interfaces were studied. Large horizontal gradients in temperature, water-vapor content, wind speed and direction, and turbulence intensity near shorelines present a challenge for numerical model prediction. The Shoreline Environment Atmospheric Dispersion Experiment (SEADEX) studied the fate of materials released to the atmosphere at coastal nuclear power plants during onshore wind-flow conditions. The SEADEX study centered around the Kewaunee, Wisconsin nuclear power plant on the western shore of northern Lake Michigan. The network included meteorological towers and surface samplers for sulfur hexafluoride (SF_6), which was released 45 m above the surface at the plant site. Tetroons were released hourly from the surface, and an oil fog was released from the same point as the SF_6. The oil fog was tracked by airborne and mobile surface lidar, while the tetroons, set to remain at selected altitudes (usually near 150 m), were tracked by NOAA radar. 3 figures.

29176 (ANL—82-65-Pt.4, pp 18-20) **Observations of fine particle behavior affected by precipitation events.** Johnson, S.A.; Sisterson, D.L.; Kumar, R. Jan 1984. NTIS, PC A04/MF A01. Order Number DE84009129. TI84009129

In Radiological and Environmental Research Division annual report, January-December 1982. Atmospheric physics. Part 4.

In an effort to examine the relationships between local atmospheric aerosol properties and precipitation scavenging, a modified Lundgen cascade impactor was used to sample ambient aerosols before, during, and after precipitation events. The precipitation was sampled using a standard wet/dry collector site. The chemical composition and mass loading (dry weight) of ambient submicron aerosol particles (0.3 to 1.0 μm aerodynamic diameter) were determined during 25 individual precipitation events over a 12-month period. Chemical analyses were carried out with Fourier-transform infrared absorption spectroscopy for the fine-particle aerosols and with established wet-chemical analyses for the precipitation samples. The meteorological and limited air-quality data collected for each precipitation event were examined to investigate the factors responsible for the observed behavior of the aerosol particles. In this report, only the variations in aerosol mass and chemistry in relation to specific precipitation events are discussed. 3 references, 1 figure.

29177 (ANL—82-65-Pt.4, pp 21-23) **Determination of outliers in the weekly-versus-event precipitation chemistry study.** Sisterson, D.L. Jan 1984. NTIS, PC A04/MF A01. Order Number DE84009129. TI84009129

In Radiological and Environmental Research Division annual report, January-December 1982. Atmospheric physics. Part 4.

A method for determination and elimination of outliers in weekly-versus-event precipitation chemistry studies is necessary to ensure that high quality data is used. In this study, weekly precipitation weighted sums of event samples collected by Argonne National Laboratory (ANL) are compared to weekly precipitation samples analyzed by the National Atmospheric Deposition Program (NADP). Samples affected by collector malfunction or obvious contamination (bird excrement, etc.) were not included in the data set. Outliers were found by scrutinizing the data with regard to ion balance, sample completeness, and statistical determination of ANL/NADP pairs that showed unusually large difference in chemical concentrations of ionic species. 3 references, 1 figure.

29178 (ANL—82-65-Pt.4, pp 28-33) **Indications of nonlinearities in processes of wet deposition.** Lee, I.Y.; Shannon, J.D. Jan 1984. NTIS, PC A04/MF A01. Order Number DE84009129. TI84009129

In Radiological and Environmental Research Division annual report, January-December 1982. Atmospheric physics. Part 4.

Computer model runs were designed to study the relationship between ambient concentrations of SO_2 and NO_2 and concentrations of SO_4/sup =/ and NO_3^- in cloud water. Four liquid water mixing ratios were used. Both simulations and precpitation chemistry data (Toronto, Canada) show that the molar ratio SO_4/sup =//NO_3^- is 1. The initial values for SO_2/NO_2 vary between 0.5 and 2.0; the corresponding ratios obtained after 16 hours of real time simulation with the clean-air chemistry model vary between 0.6 and 2.7. This indicates that the mean clear-air transformation rate of SO_2 is smaller than that of NO_2, and that the SO_2/NO_2 ratio becomes larger downwind from the source, if dry and wet removal rates are similar for the two species. The simulation also indicates that the molar ratio SO_4/sup =//NO_3^- in cloud water increases as the ratio SO_2/NO_2 increases. However, we see clearly that the relationship between the increase of precursor SO_2/NO_2 and the increase of SO_4/sup =//NO_3^- in cloud water is nonlinear on the scale examined, and that the degree of this nonlinear response becomes more significant for cases when the total mass density of the cloud condensation nuclei in air is assumed to be invariant (Model B). This nonlinear response can also be seen in the pH values. The cloud water pH decreases slowly with increasing input ratio SO_2/NO_2 for a given value Q of liquid water mixing ratio, and increases slowly with increasing Q when the ratio SO_2/NO_2 is fixed. 8 references, 2 figures, 1 table.

29179 (ANL—82-65-Pt.4, pp 34-38) **Effects of cloud dynamics on cloud-water acidification.** Lee, I.Y. Jan 1984. NTIS, PC A04/MF A01. Order Number DE84009129. TI84009129

In Radiological and Environmental Research Division annual report, January-December 1982. Atmospheric physics. Part 4.

Numerical simulations have been carried out with a model that simulates in-cloud chemical reactions and dynamic and microphysical processes of cumulus cloud development. The in-cloud chemical processes are constructed under the assumptions that (1)

the cloud droplets form on condensation nuclei whose water-soluble portion is composed of H_2SO_4, $(NH_4)_2SO_4$, and NH_4NO_3, and (2) the cloud water is in equilibrium with gas-phase chemical species of SO_2, NH_3, CO_2, and HNO_3. The in-cloud chemistry model is coupled with a cloud model. The cloud model represents cloudy and clear regions by two concentric air columns - an inner cylindrical column corresponding to the cloud region and an outer annular column corresponding to the surrounding clear region. Both lateral eddy mixing and dynamic entrainment of air variables are included to study the influence of changes in the environment on cloud development and vice versa. The combined model computes temporal changes in dynamic variables such as vertical velocity, temperature, water vapor and liquid water mixing ratios, chemical species concentrations, and aqueous chemical variables such as pH values in the cloud water and ionic concentrations of species involved in the cloud acidification processes. The cloud model conserves the integral properties of the system of cloud plus environment such as total water substance and moist static energy. 6 references, 3 figures, 1 table.

29180 (ANL—82-65-Pt.4, pp 39-44) **Relative contribution to sulfur atmospheric concentrations and deposition from long-range transport.** Shannon, J.D. Jan 1984. NTIS, PC A04/MF A01. Order Number DE84009129. TI84009129

In Radiological and Environmental Research Division annual report, January-December 1982. Atmospheric physics. Part 4s.

The contribution of long-range transport to atmospheric concentrations and deposition of sulfur is discussed. Pollutant sulfur air concentrations and deposition resulting from sources from 200 to beyond 1000 km for January and February are illustrated. Results indicate that dry deposition is a continuous process while wet deposition is episodic. Thus wet deposition fields exhibit a greater long-range component than do dry deposition fields. 1 reference, 5 figures.

29181 (ANL—82-65-Pt.4, pp 45-49) **Evaluation of wind field interpolation schemes used in studies of regional-scale pollutant transport.** Sheih, C.M. Jan 1984. NTIS, PC A04/MF A01. Order Number DE84009129. TI84009129

In Radiological and Environmental Research Division annual report, January-December 1982. Atmospheric physics. Part 4.

A study evaluated the four numerical schemes most commonly used by modelers for spatial interpolation of wind data from few observation stations. The schemes tested include: inverse distance weighting; inverse distance-squared weighting; inverse distance-squared and directional weighting; using data at the nearest station. 1 reference, 3 figures, 1 table.

29182 (ANL—82-65-Pt.4, pp 50-52) **Simulations of mesoscale motions over Lake Michigan with a planetary boundary layer model.** Lee, I.Y. Jan 1984. NTIS, PC A04/MF A01. Order Number DE84009129. TI84009129

In Radiological and Environmental Research Division annual report, January-December 1982. Atmospheric physics. Part 4.

Numerical simulations have been conducted to investigate the effects of Lake Michigan on mesoscale motions. A two-layer planetary boundary layer (PBL) model has been expanded to include three layers: the conventional PBL, a convective layer on top of the PBL, and the free atmosphere above. The dynamic parameters within the convective layer and the free atmosphere are computed according to synoptic conditions. The depth of the PBL and the average values of the fields within it are determined by numerically integrating the pertinent vertically averaged conservation equations. The horizontal distribution of the convective layer wind, temperature, and moisture content, plus associated vertical gradients, are required for boundary conditions at the top of the PBL, and the surface topography and physical parameters of the surface are necessary for lower boundary conditions. The fluxes of variables at the surface and at the interface are calculated and a prognostic equation for surface temperature variation is solved that takes into account solar and terrestial radiation, sensible heat flux, and latent heat flux of evaporation. 2 references, 4 figures.

29183 (ANL—82-65-Pt.4, pp 53-56) **Effects of surface wetness on the behavior of airborne particles.** Lee, I.Y.; Wesely, M.L. Jan 1984. NTIS, PC A04/MF A01. Order Number DE84009129. TI84009129

In Radiological and Environmental Research Division annual report, January-December 1982. Atmospheric physics. Part 4.

Temporal evolution and steady state profiles of charger (< 0.05 μm) and nephelometer (> 0.2 μm) particle concentrations were investigated. More charger particles are produced at high relative humidity and conversely for nephelometer particles. The steady state concentration profiles indicate that the phenomena of psuedofluxes may occur over wet surfaces, namely, upward fluxes of charge particles and downward fluxes of nephelometer particles, if the eddy fluxes are directed in accordance with normal flux/gradient relationships. 5 references, 3 figures.

29184 (ANL—82-65-Pt.4, pp 57-58) **Transport of gases and particles through poorly mixed interfacial sublayers.** Wesely, M.L. Jan 1984. NTIS, PC A04/MF A01. Order Number DE84009129. TI84009129

In Radiological and Environmental Research Division annual report, January-December 1982. Atmospheric physics. Part 4.

A discussion of transport of gases and particles through poorly mixed interfacial sublayers is presented. It is suggested that a transfer mechanism associated with bubbles partially short-circuits the high resistance to verticle transport of nonreactive gases through the water skin. The transfer of submicron particulate sulfate may, as in the case of gas transfer, be accelerated by means which short-circuit the resistance of the sublayer. For example, there seems to be some process that accomplishes this enhanced transport of air-borne submicron particulate sulfur to aerodynamically rough surfaces (Wesely et al., 1983). The transfer velocity at moderate wind speeds in atmospherically unstable conditions seems to be enhanced by more than an order of magnitude, but the extent of enhancement in near-neutral and stable atmospheric conditions is usually much smaller. 4 references.

29185 (ANL—82-65-Pt.4, pp 59-61) **Parameterizations of evapotranspiration and sensible heat flux from field grass.** Cook, D.R. Jan 1984. NTIS, PC A04/MF A01. Order Number DE84009129. TI84009129

In Radiological and Environmental Research Division annual report, January-December 1982. Atmospheric physics. Part 4.

A model that parameterizes evapotranspiration was used to develop parameterizations of both evapotranspiration and sensible heat flux. Data used are from the June 1982 Dry Deposition Intercomparison Experiment near Champaign, Illinois. The smaller than expected measurements of evapotranspiration during the experiment indicate that evaportranspiration was being hindered or suppressed by some factor. Heavy matting, of grass mowed a month before the experiment and the apparently quasi-senescent state of the grass during the experiment may have resulted in a condition of less than free transpiration. This is suggested by the relative insensitivity of the model to a wide range of soil moisture. Therefore, atypical conditions existed during the experiment, resulting in parameterizations which may be atypical. 5 references.

29186 **(BNL—34692) Atmosphere as stockroom and pre-reactor for gas-liquid reactions.** Schwartz, S.E. (Brookhaven National Lab., Upton, NY (USA)). Apr 1984. Contract AC02-76CH00016. 10p. (CONF-840489—2). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE84011918.

From Gas-liquid chemistry of natural waters conference; Upton, NY, USA (1 Apr 1984).

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The basic considerations involved in aqueous-phase reactions of atmospheric gases are reviewed and a skeletal framework of the formalism by which the rates of these processes may be evaluated is presented. To accomplish such evaluations for the ambient atmosphere requires inputs that must be derived from laboratory or field measurements. 37 references.

29187 **(GKSS—83/E/61) Meteorological investigations at the wind test site Pellworm.** Mengelkamp, H.T. (GKSS-Forschungszentrum Geesthacht G.m.b.H., Geesthacht-Tesperhude (Germany, F.R.)). 1983. 35p. (CONF-8305191—1). NTIS (US Sales Only), PC A03/MF A01. Order Number DE84751475.

From 3. international meeting of test stations for SWECS; Pellworm, F.R. Germany (3 May 1983).

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The GKSS Research Center Geesthacht carries out a test program for small wind energy conversion systems on the island of Pellworm. As part of this program the required meteorological parameters are measured at two towers of 10 and 45 meters height. Basic statistics of wind speed and wind direction are shown for the year 1982. The determination of the two-parameter Weibull distribution for the wind speed and its application to wind power estimation are described.

29188 (ORNL—6009, pp 52-65) **Terrestrial ecology.** Apr 1984. NTIS, PC A09/MF A01. Order Number DE84010672. TI84010672

In Environmental Sciences Division annual progress report for period ending September 30, 1983.

Research projects discussed include advances in ecosystem theory, consequences of habitat selection for mosaic elements on animal communities, the National Environmental Research Park Study Center, physiological responses of soybeans to simulated acid rain and gaseous air pollutants, influence of environmental factors on plant response to atmospheric pollutants, multielemental analysis of tree rings as an indicator of historical exposure to air pollutants, sources of acidity in east Tennessee forest soils, radionuclides in the environment, and changes in forest community biomass projected from CO_2-induced warming. (ACR)

5002 Chemicals Monitoring And Transport

REFER ALSO TO CITATION(S) 27797, 27798, 27801, 27866, 28571, 28898, 29053, 29175, 29241, 29262, 29266, 29268, 29273, 29300, 29312, 29469

29189 (ANL—82-65-Pt.4, pp 12-15) **Tracer studies of pollutant dispersion in a street canyon.** DePaul, F.T.; Sheih, C.M. Jan 1984. NTIS, PC A04/MF A01. Order Number DE84009129. TI84009129

In Radiological and Environmental Research Division annual report, January-December 1982. Atmospheric physics. Part 4.

Pollutant transport and dispersion in an urban street canyon when the ambient wind direction aloft is perpendicular to the canyon have been studied with use of an inert gas tracer. All measurements were taken in downtown Chicago at a street canyon 80 m long. 33.5 m high, and 24.5 m wide. Sulfur hexafluoride (SF_6) was chosen to simulate the pollutant source because there is minimal interference from background sources, SF_6 can be accurately measured at concentrations of parts per trillion (PPT), and emission rates can be easily controlled. The gas concentrations were measured by electron-capture detection following use of a gas chromatograph equipped with a 20-A molecular sieve for gas-phase separation.

29190 (ANL—82-65-Pt.4, pp 16-17) **Experimental studies of aerosol size distribution in a street canyon.** DePaul, F.T.; Sheih, C.M. Jan 1984. NTIS, PC A04/MF A01. Order Number DE84009129. TI84009129

In Radiological and Environmental Research Division annual report, January-December 1982. Atmospheric physics. Part 4.

Aerosol size distributions have been measured in a city street canyon with moderate traffic density in order to characterize the local aerosol and to determine the size fraction of aerosol transported from local sources within the canyon to the flow region aloft. The street canyon examined was one block (80 m) long, and each side was ten stories (~ 34 m) high. Instrumentation consisted of two electrical aerosol analyzers (EAA) for counting particles with diameters of 0.006 to 1 μm and an optical particle counter (OPC) for diameters of approximately 0.3 to 20 μm. The EAAs were coupled to operate simultaneously at staggered size classifications in order to avoid errors that could result if one were to assume no temporal variation in concentration between successive channels. 2 figures.

29191 (ANL—82-65-Pt.4, pp 24-27) **Urban influences on local precipitation chemistry during winter and spring.** Sisterson, D.L. Jan 1984. NTIS, PC A04/MF A01. Order Number DE84009129. TI84009129

In Radiological and Environmental Research Division annual report, January-December 1982. Atmospheric physics. Part 4.

Precipitation samples collected at Chicago's lakefront and at Argonne National Laboratory (~ 40 km SW) during the period June 1981 through May 1982 were analyzed to investigate urban influences on local precipitation chemistry. The Argonne (ANL) and Chicago (CHI) sample pairs were stratified according to wind direction, and wet deposition values normalized by precipitation amount were used in the comparison to minimize some of the potential effects of spatial variability of convective and stratiform storms. This report characterizes the 16 pairs of weekly samples that were collected through the second half, or winter and spring (December 1981 - May 1982) of the study period. 3 references, 1 table.

29192 **(BNL—34565-Rev.1) Urban and local source effects on precipitation chemistry.** Lipfert, F.W.; Dupuis, L.R.; Alvarez, L.M. (Brookhaven National Lab., Upton, NY (USA)). Mar 1984. Contract AC02-76CH00016. 23p. (CONF-840612—9-Rev.1). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE84011848.

From Air Pollution Control Association annual meeting; San Francisco, CA, USA (25 Jun 1984).

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Precipitation chemistry measurements from the literature are compared in order to deduce the effects of local, urban and point sources on the patterns of concentrations in wet deposition. The hypothesis to be evaluated is that excess urban or local wet deposition will be related proportionally to local air quality. Empirical relationships are developed from these data which show consistent effects in wet SO_4^{2-}, and Ca^{++} concentrations due to urban sources. The urban excess in SO_4^{2-}, with respect to regional background, is well correlated with SO_2 air quality and emission density. Excess Ca^{++} is related to the non-sulfate portion of TSP air concentrations. Downwind of local sources, excess concentrations fall off more or less linearly up to 50 to 100 km from the source; but the important question is the function of source emissions which is deposited locally. Based upon the empirical relationships established between excess urban and point source wet SO_4^{2-} and local SO_2 air quality, a simple algorithm is developed which relates the fraction deposited locally to the air quality impact of the source and the source strength. The algorithm suggests that the air quality impact is dominent over the source strength, which is in qualitative agreement with other studies in the literature regarding the fractional deposits for low-stack sources and conversely for higher-stack sources. 29 references, 6 figures, 4 tables.

29193 **(BNL—34566-Rev.1) Statistical analysis of relationships between precipitation chemistry and air quality in New Hampshire and precursor emissions.** Lipfert, F.W.; Kaplan, E.; Daum, M. (Brookhaven National Lab., Upton, NY (USA)). Mar 1984. Contract AC02-76CH00016. 33p. (CONF-840612—10-Rev.1). NTIS, PC A03/MF A01; GPO Dep. Order Number DE84011847.

From Air Pollution Control Association annual meeting; San Francisco, CA, USA (25 Jun 1984).

The information in this paper is directed towards those concerned with the chemistry of precipitation in remote regions of the Northeastern US and its relationships to air concentrations and emissions of precursors (SO/sub x/ and NO/sub x/). Furthermore, the paper deals with statistical methods for the time series analysis of data available only at incongruent time intervals. The long-term precipitation chemistry data base from the Hubbard Brook (N.H.) Ecosystem Study is analyzed for trends and interrelationships with other relevant parameters, including atmospheric aerosol concentrations, atmospheric turbidity (expressed as light-scattering), and emissions of precursor air pollutants from various regions in the US

and Canada. Robust relationships are found between nitrate in rain and NO/sub x/ emissions, and between ammonium in rain (presumed to have been derived from ammonium sulfate aerosol) and SO_2 emissions. The relationship between sulfate in rain and SO_2 emissions was found to be dependent on the corrections and quality control criteria applied to the data, but was in general less statistically significant and not proportional (a substantial sulfate intercept). This intercept could either be interpreted as a non-linearity in the source-receptor relationship or as a misspecification of the appropriate emission terms (combination of source regions). 28 references, 6 figures, 5 tables.

29194 **(BNL—34735) Kinetics of some aqueous-phase reactions of peroxyacetyl nitrate.** Lee, Y.N. (Brookhaven National Lab., Upton, NY (USA)). Apr 1984. Contract AC02-76CH00016. 10p. (CONF-840489—4). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE84011911.

From Gas-liquid chemistry of natural waters conference; Upton, NY, USA (1 Apr 1984).

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The contribution to cloudwater acidification by reactions of peroxyacetyl nitrate (PAN) with various atmospheric species reported in this work. Clearly, at representative concentration of PAN ($\leqq 5 \times 10^{-9}$ atm), the reactions which have been studied here are not fast enough to contribute significantly to acid formation in the cloudwater. One exception might be the reaction between PAN and S(IV) at higher pH ($\geqq$ 5.6) although few cloud or rain samples collected have shown pH values higher than this value. It was also noted that PAN does not produce H_2O_2 from its hydrolysis and aqueous reactions with O_2 and O_3. Based on this study it is concluded that in spite of its greater solubility, PAN is not an important precursor of acid or oxidant for the cloudwater and its atmospheric residence time is not affected by wet removal processes; these properties would enhance the importance of this species as a long-range transporting reagent of NO/sub x/. 16 references, 7 figures.

29195 **(BNL—34740) Biogenic and anthropogenic carbonaceous aerosols and their precursors within a forest canopy.** Tanner, R.L.; Gaffney, J.S. (Brookhaven National Lab., Upton, NY (USA)). 1984. Contract AC02-76CH00016. 14p. (CONF-840612—7). NTIS, PC A02/MF A01; GPO Dep. Order Number DE84011845.

From Air Pollution Control Association annual meeting; San Francisco, CA, USA (25 Jun 1984).

Paper No. 84-16.2.

The purpose of this study is to explore the use of thermal evolution techniques, ^{14}C and ^{13}C isotopic measurements, and allied approaches for distinguishing carbonaceous aerosol source terms using new data acquired in a forest canopy study - POLlutant - TERpene CAnopy Interaction STudy (POLTERCAIST) - conducted using instrumented towers near Oak Ridge, TN, July 1983 and March 1984. A thermal evolution technique is used to differentiate organic from elemental carbon in aerosol samples. Carbon-14 measurements using gas proportional counting are used to distinguish biogenic carbon (equilibrated with atmospheric $^{14}CO_2$) from anthropogenic carbon, the latter overwhelmingly fossil fuel-derived and thence containing no ^{14}C (half-life $\approx$ 5800 yr). $^{13}C/^{12}C$ isotopic ratios are measured to correct for fractionation but also allow differentiation of C4 and C3 plant material, e.g. slash-burning of crop residues from wood-burning sources. Previous data from a weekly sample taken at the BNL site on Long Island, NY and from a composite sample taken at Barrow, AK (March 1981), indicate about 30% biogenic sources with $^{13}C/^{12}C$ ratios appropriate for a mix of wood-burning and fossil fuel sources. 31 references, 2 figures, 3 tables.

29196 **(BNL—34741) Atmospheric aqueous-phase reactions of nitrogen species.** Lee, Y.N. (Brookhaven National Lab., Upton, NY (USA)). Apr 1984. Contract AC02-76CH00016. 11p. (CONF-840489—3). NTIS, PC A02/MF A01; GPO Dep. Order Number DE84011844.

From Gas-liquid chemistry of natural waters conference; Upton, NY, USA (1 Apr 1984).

The current understanding of aqueous-phase nitrogen compounds as pertaining to acid formation are summarized and possible contributing reaction systems are examined. The discussion includes consideration of first-order reaction kinetics as acid forms in solution, gas-liquid reactions of atmospheric nitrogen species, mass transfer considerations and important reaction systems. 27 references, 3 figures.

29197 **(BNL—51725) Rapid determination of ppB levels of aldehydes in ambient air by high-performance liquid chromatography.** Meng, Z.; Tanner, R.L. (Brookhaven National Lab., Upton, NY (USA)). Jun 1983. Contract AC02-76CH00016. 60p. NTIS, PC A04/MF A01; GPO Dep. Order Number DE84011584.

A simple technique is described for determining ambient atmospheric levels of formaldehyde and acetaldehyde using impinger collection in acidified 2,4-dinitrophenylhydrazine/acetonitrile solution and direct analysis by high-performance liquid chromatogrpy-uv absorbance detection of the corresponding phenylhydrazone derivatives on reversed-phase columns. A limit of detection of $\sim$ 1 ppB for 1-hr impinger collections is obtained. Data from a coastal NE USA site showed no discernable diurnal trends, but strong seasonal variations in the levels of both formaldehyde and acetaldehyde were observed, with summer maxima and winter minima. Formaldehyde/acetaldehyde ratios were relatively high (>4) in winter and spring, but were low (<2) in summer and fall. 18 references, 18 figures, 20 tables.

29198 **(CONF-840374—3) Simulation modeling of atmospheric deposition of sulfur from biogenic and anthropogenic emissions.** Shannon, J.D. (Argonne National Lab., IL (USA)). 1984. Contract W-31-109-ENG-38. 9p. NTIS, PC A02/MF A01; GPO Dep. Order Number DE84011698.

From APCA specialty meeting on environmental impact of natural emissions; Research Triangle Park, NC, USA (7 Mar 1984).

A biogenic sulfur emission inventory for the eastern United States and immediately adjacent portions of Canada is used in the ASTRAP model to estimate biogenic contributions to wet and dry sulfur deposition and atmospheric sulfate concentration, under the conservative assumption that all biogenic sulfur is transformed to sulfate. Simulations for summer conditions, in which biogenic sulfur emissions are greatest, are compared with simulations of transport and deposition of anthropogenic emissions of sulfur. The biogenic contribution to sulfur deposition during summer is shown to have a relative maximum in the southeastern US, about 5 to 10% of the total deposition from combined anthropogenic and biogenic sources, with only a 1 to 2% biogenic contribution indicated in the northeastern US. 5 references, 2 figures, 2 tables.

29199 **(CONF-840415—21) Current status of measurement techniques and levels of formaldehyde in residences.** Gammage, R.B.; Hawthorne, A.R. (Oak Ridge National Lab., TN (USA)). Apr 1984. Contract AC05-84OR21400. 31p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE84011660.

From 187. national meeting of the American Chemical Society; St. Louis, MO, USA (8 Apr 1984).

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For measuring levels of formaldehyde in residences, the trend is toward the increased use of passive integrating monitors. This popularity is due to ease of use, cost-effectiveness, ability to provide time-weighted-average concentrations over periods of one or more days and a sensitivity sufficient to make accurate measurements down to a few times 0.01 ppM. The more traditional modified NIOSH method lacks the sensitivity to make accurate measurements at the 0.1 ppM or lower concentrations that are encountered frequently inside houses. It is desirable that more rigorous intercomparisons of various monitoring systems be conducted, both under laboratory and field conditions. The age of urea formaldehyde-resin containing sources is a most important parameter; as the sources age they emit formaldehyde less strongly. Marked dependence of formaldehyde concentration on age is observed for different classes of dwellings, including modern conventional houses. Levels of formaldehyde generally average about 0.03 ppM in older conventional homes. In mobile homes and a fraction of new and urea formaldehyde foam insulation (UFFI) homes, mean levels of formaldehyde frequently exceed 0.1 ppM. More systematic data are needed on the frequency and magnitude of short-term peak exposures as well as long-term seasonal variations in levels of formalde-

hyde. Limited studies have revealed diurnal and seasonal within-house fluctuations of two and tenfold, respectively. Occasional excursions to 0.1 ppM seem to occur in the majority of houses. 39 references, 4 figures, 4 tables.

29200 **(CONF-840415—22) Formaldehyde emissions from combustion sources and solid formaldehyde resin containing products: potential impact on indoor formaldehyde concentrations.** Matthews, T.G.; Reed, T.J.; Tromberg, B.J.; Daffron, C.R.; Hawthorne, A.R. (Oak Ridge National Lab., TN (USA)). 12 Apr 1984. Contract AC05-84OR21400. 31p. NTIS, PC A03/MF A01; GPO Dep. Order Number DE84011630.

From 187. national meeting of the American Chemical Society; St. Louis, MO, USA (8 Apr 1984).

The formaldehyde (CH_2O) emission rates of combustion sources and solid CH_2O resin-containing products commonly found in domestic environments are surveyed. The potential impact of these sources on indoor CH_2O concentrations are estimated using simple steady-state, indoor pollutant concentration models. Source emission rates, product loadings for solid emission sources, duty cycles for combustion sources, and potential permeation barriers are considered in the model. The strongest contributors to indoor CH_2O are pressed-wood products and foam insulation containing urea formaldehyde resins. Combustion sources and phenol-formaldehyde resin-bonded products are generally weak emitters. 26 references, 1 figure, 9 tables.

29201 **(CONF-8306196—1) Chemical characterization of selected military obscurants.** Brazell, R.S.; Holmberg, R.W.; Moneyhun, J.H. (Oak Ridge National Lab., TN (USA)). 1983. Contract W-7405-ENG-26. 12p. NTIS, PC A02; 3; GPO Dep. Order Number DE84003202.

From Chemical Systems Laboratories conference on obscuration and aerosol research; Aberdeen Proving Ground, MD, USA (20 Jun 1983).

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Various smokes and obscurants have been analyzed and defined chemically in support of inhalation toxicology studies designed to evaluate the risk associated with passive or accidental troop exposure. The chemical characterization is to identify constituents useful for monitoring the exposure environment to assure a compositionally uniform aerosol for the exposure studies and to assist in evaluating the toxicological hazards. The characterization also allows for comparisons of the smokes produced under controlled laboratory conditions and those produced under more variable field conditions to assess the relevancy of the inhalation studies. Smokes which have been examined include those produced from diesel oil, fog oil, red phosphorus containing butyl rubber, and white phosphorus contained in a felt matrix. A brief discussion of the major findings on all the smokes is included in this report. Specific compositional changes which relate to the generation environment are also described for some aerosols.

29202 **(DOE/ER/60023—T1) Humidity/cloud-radiation feedback on possible climatic perturbation due to fossil fuel utilization. Technical progress report.** Wang, W.C. (Atmospheric and Environmental Research, Inc., Cambridge, MA (USA)). Apr 1984. Contract AC02-81ER60023. 4p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE84011895.

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Research progress is reported on studies at the contribution of atmospheric N_2O, CH_4, and CFCs to the earth's clear sky infrared radiation budget, the incorporation of the cumulus convection scheme into the 1-D tropical model, the cloud altitude feedback effect, and an ongoing radiation models intercomparison program. (ACR)

29203 **(DOE/ER/60186—3) Deposition of submicron particles on rough surfaces in fully developed turbulent flow.** Hahn, L.A. (Illinois Univ., Urbana (USA). Dept. of Civil Engineering). 1982. Contract AC02-83ER60186. 49p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE84010829.

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An open flow system was used to examine the deposition rates of submicron particles on rough walls under fully developed turbulent flow conditions in order to better understand the mechanisms neeeded to reduce airborne radioactivity in uranium mines. Mine excavation produces tunnel surfaces that can be modeled as a repeated rib geometry. This pattern was simulated in the lab by assembling thick and thin walled aluminum rings in a stainless steel pipe. A monodisperse aerosol was generated from a 1% uranium solution using a constant output atomizer, a diffusion drier, and an electrostatic classifier. Mass deposition was determined utilizing fluorescence spectroscopy. The dependence of deposition velocities on submicron particle size and roughness configuration was investigated. The results were found to be consistent, within experimental error, with a deposition model proposed by Kader and Yaglom. Their model was found to accurately predict deposition velocities for the wide range of roughness configurations investigated. 23 references, 10 figures, 1 table.

29204 **(DOE/NBM—4012797) Environmental monitoring report: Morgantown Energy Technology Center, calendar year 1983.** (USDOE Morgantown Energy Technology Center, WV). 1984. 90p. NTIS, PC A05/MF A01; 1; GPO Dep. Order Number DE84012797.

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Environmental studies are an integral part of the Morgantown Energy Technology Center's (METC) fossil energy research program. In 1983, METC's environmental management program extended to cover the treatment and disposal of all wastewater generated at METC; the disposal of solid and hazardous waste generated by METC; and the monitoring of surface water, groundwater, and air quality in the surrounding area. METC's treatment system for sanitary wastes operated effectively throughout Calendar Year (CY) 1983. Industrial wastewater discharged by METC exceeded the permitted limits for cadmium and phenolics in CY 83. The source of low-level cadmium contamination is unknown at this time, but remains under investigation. In the last quarter of CY 83, discharge limits for phenolics were exceeded due to the development of leaks in process equipment of the gasification pilot plant, which is now being mothballed. This caused an overloading of METC's wastewater treatment system. METC is engaged in the construction of a new wastewater treatment facility for the correction of discharge problems. The facility is scheduled to be completed by late 1985. The monitoring of groundwaters in METC's industrial waste holding areas revealed that no contamination of groundwaters had occurred in CY 83. In 1983, all solid and hazardous wastes generated at METC were tested for EP toxicity and disposed of in an Environmental Protection Agency (EPA) approved secure landfill. Routine inspections revealed that landfill operators and hazardous waste disposal contractors for METC wastes were in compliance with the Resource Conservation and Recovery Act (RCRA) requirements. Air monitoring was performed at on- and off-site stations in CY 83 to satisfy the National Environmental Policy Act requirements. Data collected in CY 83 has not been reduced at this time; however, data collected from previous years indicates that METC project emissions have negligible impact on air quality. 8 references.

29205 **(DOE/PC/61254—T1) Aerosol signatures for receptor modeling. Project report, August 1, 1983-January 31, 1984.** Hughes, J.M. (Virginia Polytechnic Inst. and State Univ., Blacksburg (USA)). Jan 1984. Contract AC22-83PC61254. 47p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE84011153.

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This project made use of an airborne platform for aerosol sampling. Two regional background sampling flights of nine hours each were carried out over the Wayne National Forest in Eastern Ohio. One aerosol sampling run was carried out at the Kraft Paper Mill in Chillicothe, Ohio. Two aerosol sampling flights were conducted in power plant plumes in West Virginia. Emissions at the Harrison West Virginia Power Station were controlled with precipitators while at the Pleasants Power Station they were controlled with an electrostatic precipitator and a scrubber. A micro-orifice impactor furnished by V.A. Marple at the University of Minnesota and a teflon cyclone extraction impactor unit furnished by R.K.

Stevens at EPA were both operated during these sampling flights. After the collected size fractionated aerosols are analyzed for elemental composition at EPA and the University of Maryland, a so called aerosol signature can be constructed. The aerosol signatures for the background, the paper mill, and the two coal fired power plants will be for use in receptor modeling studies. 5 figures, 11 tables.

29206 **(DP-MS—83-12-Rev.2) Sulfur dioxide, carbon dioxide, and water vapor flux measurements utilizing a microprocessor controlled data acquisition system in a pine plantation. Rev. 2.** Lorenz, R.; Murphy, C.E. Jr. (Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Lab.). 1984. Contract AC09-76SR00001. 19p. NTIS, PC A02/MF A01; GPO Dep. Order Number DE84012062.

A microprocessor controlled data acquisition system was utilized to determine the flux densities of sulfur dioxide (SO_2), carbon dioxide (CO_2), and water (H_2O) vapor above a young lob-lolly pine plantation. The average flux densities for SO_2, CO_2, and H_2O vapor for measurement periods scattered throughout the year, for this stand, were found to be 0.052 $gm^{-2}sec^{-1}$, 0.72 $mgm^{-2}sec^{-1}$, and 85 $mgm^{-2}sec^{-1}$, respectively. The experimental design, system controls, measurement techniques, control logic, and some results obtained are discussed. 11 references, 7 figures, 1 table.

29207 **(EPRI-EA—3466) Atmospheric retention of anthropogenic CO_2: scenario dependence of the airborne fraction. Final report.** Perry, A.M. (Oak Ridge National Lab., TN (USA)). May 1984. Contract AC05-84OR21400. 63p. NTIS, PC A04/MF A01; 1 - EPRI; GPO Dep. Order Number DE84012079.

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Carbon dioxide (CO_2) production from human activities, notably fossil fuel combustion, will contribute to future increases in the CO_2 concentration in the earth's atmosphere. The fraction of cumulative future CO_2 production that will remain in the atmosphere, as a function of time, was calculated for 19 hypothetical scenarios for worldwide CO_2 production, using two quite different models of the global carbon cycle. Over a wide range of assumed values for total cumulative CO_2 production and for initial (post-1980) rates of growth of annual CO_2 production, the airborne fractions for the various scenarios correlate well with the maximum annual CO_2 production rate attained in each scenario. For scenarios in which the peak CO_2 production rate is 10 to 20 times the present rate, the airborne fraction may exceed 0.8; for scenarios with peak production rates 2 to 3 times the present rate, the airborne fraction is estimated to be around 0.6. Present carbon-cycle models may not correctly estimate the distribution of CO_2 among the major global carbon reservoirs, but the upward trend in airborne fraction with increasing annual carbon release rate is plausible and probably real. 22 references, 40 figures, 11 tables.

29208 **(EPRI-EA—3500) Evaluation of simulated acid precipitation effects on forest microcosms. Final report.** Kelly, J.M.; Strickland, R.C.; Weatherford, F.P.; Noggle, J.C. (Tennessee Valley Authority, Muscle Shoals, AL (USA). Div. of Air and Water Resources). Apr 1984. 184p. EPRI-RRC, Box 50490, Palo Alto, CA 94303. Order Number DE84920329.

Microcosms were treated for a 30-month period with simulated precipitation acidified to four pH levels (5.7, 4.5, 4.0, and 3.5) to evaluate the impact of acid precipitation on foliar leaching, plant nutrient content, soil leaching, soil nutrient content, and litter decomposition. Direct effects of acid precipitation on diameter growth, bud break, leaf senescence, chlorophyll content, stomatal size, stomatal density, photosynthesis, respiration, transpiration, and cuticle erosion were evaluated on tulip poplar, white oak, and Virginia pine seedlings growing as mixed stands in the microcosms. None of the plant physiological or morphological parameters evaluated responded in a statistically significant manner as a result of treatment. A significant treatment canopy interaction was observed in the form of a 60 percent increase in calcium input in throughfall in response to the pH 3.5 treatment. Foliar nutrient content did not change in response to treatment nor did field measurements of decomposer activity. Soil analysis indicated a significantly lower concentration of exchangeable calcium and magnesium in the top 3.5 cm of the mineral soil in association with the pH 3.5 treatment. Soil leachate concentrations exhibited significant increases at both the 25 and 50 cm depths. However, at the 100 cm depth no significant response in concentration or elemental loss from the system was observed. Laboratory respiration measurements indicated a small, but statistically significant reduction in decomposer activity in the lower litter (02) horizon. This reduction was masked in the field measurements of decomposer activity due to the relatively small contribution of the 02 to total soil respiration. 38 references, 12 figures, 18 tables.

29209 **(GKSS—83/E/60) Parametrization of turbulent diffusion in the atmosphere using turbulent energy equation(s).** Lautenschlager, M. (GKSS-Forschungszentrum Geesthacht G.m.b.H., Geesthacht-Tesperhude (Germany, F.R.); Hamburg Univ. (Germany, F.R.). Fachbereich Physik). 1983. 110p. (In German). NTIS (US Sales Only), PC A06/MF A01. Order Number DE84751476.

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The turbulent diffusion of pollutant transport in the atmosphere is represented by means of the turbulent kinetic energy and a turbulent time scale. The turbulent energies are calculated by partial differential equations. The Crank-Nicolson method is used for time integration. The turbulent time scales are determined by fitting the results of propagation experiments.

29210 **(KFK—3545) PARDISEKO IV - a computer program for the calculation of the aerosol behaviour in closed vessels.** Bunz, H. (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Lab. fuer Aerosolphysik und Filtertechnik I; Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Projekt Schneller Brueter). Nov 1983. 30p. (In German). NTIS (US Sales Only), PC A03/MF A01. Order Number DE84751308.

This report describes the computer program PARDISEKO IV. Its purpose is to calculate the behaviour of a polydisperse aerosol system in a closed vessel as a function of the time. The main object is to describe the extensions added in comparison to the former version PARDISEKO IIIb as well as to explain the input and output.

29211 **(NUREG/CR—3488-Vol.2) Idaho field experiment 1981. Volume 2: measurement data.** Start, G.E.; Sagendorf, J.F.; Ackermann, G.R.; Cate, J.H.; Hukari, N.F.; Dickson, C.R. (National Oceanic and Atmospheric Administration, Idaho Falls, ID (USA). Air Resources Lab.). Apr 1984. 946p. NTIS, PC A99/MF A01 - GPO* $16.00. Order Number DE84901149.

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The 1981 Idaho Field Experiment was conducted in southeastern Idaho over the upper Snake River Plain. Nine test-day case studies were conducted between July 15 and 30, 1981. Releases of SF_6 gaseous tracer were made for 8-hour periods from 46m above ground. Tracer was sampled hourly, for 12 sequential hours, at about 100 locations within an area 24km square. Also, a single total integrated sample of about 30 hours duration was collected at approximately 100 sites within an area 48 by 72km square (using 6km spacings). Extensive tower profiles of meteorology at the release point were collected. RAWINSONDES, RABALS and PIBALS were collected at 3 to 5 sites. Horizontal, low-altitude winds were monitored using the INEL MESONET. SF_6 tracer plume releases were marked with co-located oil fog releases and bi-hourly sequential launches of tetroon pairs. Aerial LIDAR observations of the oil fog plume and airborne samples of SF_6 were collected. High altitude aerial photographs of daytime plumes were collected. Volume II lists the data in tabular form or cites the special supplemental reports by other participating contractors. While the primary user file and the data archive are maintained on 9 track/1600 cpi magnetic tapes, listings of the individual values are provided for the user who either cannot utilize the tapes or wishes to preview the data. The accuracies and quality of these data are described.

29212 (ORNL—6009, pp 104-124) **Department of Energy Global Carbon Cycle Program.** Apr 1984. NTIS, PC A09/MF A01. Order Number DE84010672. TI84010672

In Environmental Sciences Division annual progress report for period ending September 30, 1983.

The principal objective of this program is to develop a quantitative basis for understanding the global biogeochemical cycle of carbon and implementing simulation models to describe its dynamic behavior. Another objective of this research is to further the scientific methodology for assessing the response of the global carbon cycle - particularly changes in atmospheric CO_2 concentration - to further releases of CO_2 by fossil-fuel combustion. Mathematical models of the carbon cycle are being developed and updated with refinements in basic understanding and improved estimates of key parameters. Sensitivity and error analyses provide a basis for selecting aspects of models that require refinement. Basic data sets underlying carbon-cycle models are refined and augmented where indicated. Particular attention in both the in-house and external research projects during the past year was devoted to improving our understanding of the terrestrial component of the cycle. In this regard, the impact of land-use change on the global carbon cycle was a major area of concern.

29213 **(ORNL—6055) Inventory of research under the National Acid Precipitation Assessment Program.** Caton, G.M.; Riordan, J.M.; Oen, C. (Oak Ridge National Lab., TN (USA)). May 1984. Contract AC05-84OR21400. 650p. NTIS, PC A99/MF A01; 1; GPO Dep. Order Number DE84012049.

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This part of the Operating Research Plan describes research funded or planned by the federal sector for the years 1982 to 1985. Information was obtained from principal investigators within the National Program, federal agencies, other organizations, and individuals. The cutoff date for inclusion of information in this volume was April 16, 1984. The inventory is computerized, and is available for searching interactively.

29214 **(PB—84-145119) Research planning task group study-thermal destruction. Final report.** Binder, M.J.; Strehlow, R.A. (Advanced Environmental Control Technology Research Center, Urbana, IL (USA)). Jan 1984. 131p. NTIS, PC A07/MF A01.

The objectives of this study were to determine the state-of-the-art of thermal destruction of industrial toxic waste, and to identify and prioritize research needs in this area. Through a literature search, discussion with EPA personnel, discussions with authorities in the area of thermal destruction, and attendance at a national meeting on the subject, the state-of-the-art of thermal destruction of industrial toxic waste has been determined, and research needs which may be expected to provide useful results have been identified.

29215 **(PB—84-148170) Hydrocarbon solvent recovery in the presence of resin contaminants.** Turpin, J.L. (Arkansas Univ., Fayetteville (USA)). Jan 1984. 48p. NTIS, PC A03/MF A01.

A system was developed to recover acetone from an air stream in which epoxy resin particles were suspended. This recovery problem is encountered in the manufacture of fiber glass reinforced plastic pipe. It is representative of numerous other industrial situations which require the recovery of hydrocarbon solvents from a gaseous stream containing resin particles in order to eliminate atmospheric pollution. The system developed was a three-stage low temperature condensation process preceded by a cascade impactor. A scale model of the system was designed and constructed. It was tested in the laboratory, and on a split stream of an actual plant process.

29216 **(PB—84-148931) Health hazard evaluation determination report MHETA-82-007-9003, Bethlehem Steel, Ellsworth Coal Preparation Plant, MSHA mine i.d. 11-02632, Eighty-four, Pennsylvania.** Piacitelli, L.; Patil, A. (National Inst. for Occupational Safety and Health, Morgantown, WV (USA)). 1982. 11p. NTIS, PC A02/MF A01.

Worker exposure to a coal antifreeze agent, Nalcoal-8894, was investigated at the Ellsworth Coal Preparation facility (SIC-1211), Eighty Four, Pennsylvania. The study was requested by the United Mine Workers of America and was performed on February 23, 1982. Air samples were collected for Stoddard-solvent (8052413), the primary constituent of Nalcoal-8894. The authors conclude that no association could be found between reported symptoms and the use of Nalcoal-8894.

29217 **(PB—84-149467) Health hazard evaluation determination report number MHETA-82-006-9002, Sewell Coal Company, Number 1 Preparation Plant, Nettie, West Virginia, VA.** Patil, A.; Corwell, R.J. (National Inst. for Occupational Safety and Health, Morgantown, WV (USA)). Aug 1982. 10p. NTIS, PC A02/MF A01.

The potential health effects of exposure to a coal antifreeze agent, Wendon-NF-40 were examined. The study was requested by the United Mine Workers of America and was conducted on March 8, 1982 at the Sewell Coal Company No. 1 Preparation Facility (SIC-1211), Nettie, West Virginia. The antifreeze agent was sprayed on the coal as it fell from a conveyer belt into a large hopper. The spraying operation was enclosed except at one side. The preliminary on site investigation was conducted after the facility had discontinued using the antifreeze agent. Therefore, only bulk samples were collected for qualitative analysis. Workers were interviewed by a NIOSH physician. The qualitative analysis revealed that the primary component of the antifreeze was diethylene-glycol (111466). Two of 10 workers interviewed complained of health problems they felt were related to exposure to Wendon-NF-40. Their symptoms included headache and skin irritation. Due to lack of environmental sampling, NIOSH was unable to determine that a hazard from overexposure to Wendon-NF-40 existed. The authors suggest that organic vapor respirators should be worn by workers when they are in area where inhalation of the mists or sprays is likely.

29218 **(PB—84-156280) Effects of photochemical oxidants on plants.** Guderian, R.; Tingey, D.T.; Rabe, R. (Environmental Protection Agency, Corvallis, OR (USA). Environmental Research Lab.). Feb 1984. 426p. (EPA—600/3-84-024). NTIS, PC A19/MF A01.

Photochemical oxidants are found in 'photochemical smog' which is a complex mixture of primary and secondary air pollutants. The photochemical oxidants are secondary air pollutants formed by the action of sunlight on nitrogen oxides and reactive hydrocarbons, their precursors. The most important phytotoxic components produced by these atmospheric photochemical reactions are ozone and peroxyacetyl nitrate. Other peroxy compounds, aldehydes, ketones, organic and inorganic acids, aerosols, and nitrogen dioxide also are formed. An analysis and evaluation of the available literature was used to characterize the relationships among emissions, ambient concentrations, effects and to identify the important controlling influences on the formation and effects of photochemical oxidants. The ultimate protection of humans, animals, plants, and materials from photochemical oxidant injury requires reduction of the ambient concentration of the particular air pollutant. The available emission estimates for the precursor compounds indicate that, at least for the foreseeable future, humans and the environment will continue to be impacted by photochemical oxidants. The material for this book was selected to provide a basis for preventive measures at the emission source and at the site of impact; also to provide researchers and students with a comprehensive information base.

29219 **(PB—84-156611) Cr(VI) and other metallic mutagens in fly ash and welding fumes.** Stern, R.M.; Thomsen, E.; Furst, A. (Svejsecentralen, Glostrup (Denmark)). 1983. 29p. (R—83-38). NTIS, PC E04/MF E01.

Presented at the First International Workshop on Carcinogenic and/or Mutagenic Metals, Geneva, 11-14 September, 1983.

Particulate samples taken from both the indoor (working) and outdoor (community) environments contain a wide range of metallic trace elements most of which are mutagenic in at least one of the short term tests for genotoxicity currently in use. Because of the demonstrated presence of a short lived biologically active species (Cr(VI)), and the uncertainty with which the results of the screening of metallic compounds in short term tests can be interpreted in terms of human risk, great care must be taken to assure the appropriate collection, storage, and chemical and biological assay of such material. The sensitivity of the results for fly ash and

welding fumes to variations in these protocols is demonstrated and discussed. (Copyright (c) The Danish Welding Institute Copenhagen 1983).

29220 **(PB—84-156785) Air quality criteria for particulate matter and sulfur oxides. Volume 1. Final report.** (Environmental Protection Agency, Research Triangle Park, NC (USA). Environmental Criteria and Assessment Office). Dec 1982. 209p. (EPA—600/8-82-029A-F). NTIS, PC A10/MF A01.

See also PB84-156793.

The document evaluates and assesses scientific information on the health and welfare effects associated with exposure to various concentrations of sulfur oxides and particulate matter in ambient air. The literature through 1980-81 has been reviewed thoroughly for information relevant to air quality criteria, the document is not intended as a complete and detailed review of all literature pertaining to sulfur oxides and particulate matter. An attempt has been made to identify the major discrepancies in our current knowledge and understanding of the effects of these polluentant. Although this document is principally concerned with the health and welfare effects of sulfur oxides and particulate matter, other scientific data are presented and evaluated in order to provide a better understanding of these pollutants in the environment. To this end, the document includes chapters that discuss the chemistry and physics of the pollutants; analytical techniques; sources; and types of emissions; environmental concentrations and exposure levels; atmospheric chemistry and dispersion modeling; acidic deposition; effects on vegetation; effects on visibility, climate, and materials; and respiratory, physiological, toxicological, clinical, and epidemiological aspects of human exposure.

29221 **(PB—84-156793) Air quality criteria for particulate matter and sulfur oxides. Volume 2. Final report.** (Environmental Protection Agency, Research Triangle Park, NC (USA). Environmental Criteria and Assessment Office). Dec 1982. 624p. (EPA—600/8-82-029B-F). NTIS, PC A99/MF A01.

See also PB84-156785, PB84-156801, and PB84-120401.

The document evaluates and assesses scientific information on the health and welfare effects associated with exposure to various concentrations of sulfur oxides and particulate matter in ambient air. The literature through 1980-81 has been reviewed thoroughly for information relevant to air quality criteria, although the document is not intended as a complete and detailed review of all literature pertaining to sulfur oxides and particulate matter. An attempt has been made to identify the major discrepancies in our current knowledge and understanding of the effects of these pollutants. Although this document is principally concerned with the health and welfare effects of sulfur oxides and particulate matter, other scientific data are presented and evaluated in order to provide a better understanding of these pollutants in the environment. To this end, the document includes chapters that discuss the chemistry and physics of the pollutants; analytical techniques; sources; and types of emissions; environmental concentrations and exposure levels; atmospheric chemistry and dispersion modeling; acidic deposition; effects on vegetation; effects on visibility, climate, and materials; and respiratory, physiological, toxicological, clinical, and epidemiological aspects of human exposure.

29222 **(PB—84-156801) Air quality criteria for particulate matter and sulfur oxides. Volume 3. Final report.** (Environmental Protection Agency, Research Triangle Park, NC (USA). Environmental Criteria and Assessment Office). Dec 1982. 686p. (EPA—600/8-82-029C-F). NTIS, PC A99/MF E04.

See also PB84-156793.

The document evaluates and assesses scientific information on the health and welfare effects associated with exposure to various concentrations of sulfur oxides and particulate matter in ambient air. The literature through 1980-81 has been reviewed thoroughly for information relevant to air quality criteria, although the document is not intended as a complete and detailed review of all literature pertaining to sulfur oxides and particulate matter. An attempt has been made to identify the major discrepancies in our current knowledge and understanding of the effects of these pollutants. Although this document is principally concerned with the health and welfare effects of sulfur oxides and particulate matter, other scientific data are presented and evaluated in order to provide a better understanding of these pollutants in the environment. To this end, the document includes chapters that discuss the chemistry and physics of the pollutants; analytical techniques; sources; and types of emissions; environmental concentrations and exposure levels; atmospheric chemistry and dispersion modeling; acidic deposition; effects on vegetation; effects on visibility, climate, and materials; and respiratory, physiological, toxicological, clinical, and epidemiological aspects of human exposure.

29223 **(PB—84-161306) Summary of the 1982 National Performance Audit Program on Source Measurements.** Streib, E.W.; Midgett, M.R. (Environmental Protection Agency, Research Triangle Park, NC (USA). Environmental Monitoring and Support Lab.). Nov 1983. 56p. (EPA—600/4-83-049). NTIS, PC A04/MF A01.

See also PB83-210633.

In the spring and fall of 1982, the Quality Assurance Division conducted the National Audits for Stationary Source Test Methods. The audit materials consist of: a calibrated orifice for Method 5 (dry gas meter only), five simulated liquid samples each for Method 6 (SO2) and Method 7 (NO(x)), two coal samples for Method 19A, and a disposable gas cylinder for Method 3 (Orsat analyzer). Laboratories participating in the audits sent their data to the Source Branch and later received a written report comparing their results to EPA's.

29224 **(PNL-SA—11907) Uncertainty assessment for acid deposition.** Berkowitz, C.M.; Renne, D.S. (Pacific Northwest Lab., Richland, WA (USA)). Jan 1984. Contract AC06-76RL01830. 12p. (CONF-840269—9). NTIS, PC A02/MF A01; GPO Dep. Order Number DE84011897.

From NAPAP Task Group G peer review meeting; Burlington, VT, USA (14 Feb 1984).

Mathematical models will be used quite extensively to assess current damages and to evaluate control and mitigation strategies for acid deposition. Policy makers will rely on these models to determine the most cost-effective policy options. Source/receptor models, describing atmospheric processes in the transport, transformation, and removal of acid precursors, are among the models used in the assessment process. However, the uncertainty associated with these models needs to be quantified to allow policy makers to discriminate among various policy options. This task is designed to provide quantitative information on the uncertainty of source/receptor models due to several important atmospheric processes: interannual meteorological variability, the effect of vertical wind shear on transport calculations, the effect of temporal and spatial precipitation variability on the wet deposition calculations, and the effect of assumptions of linear chemistry in the calculations. An assessment-oriented Lagrangian model called the Advanced Statistical Regional Air Pollution Model (ASTRAP) is used against which these various atmospheric processes are compared. Interannual meteorological variability will be assessed using 16 years of meteorological data as input to ASTRAP for given emission conditions. The effects of vertical shear will be evaluated by comparing a multi-layer model output against a single-layer version of the same model, then relating this information back to ASTRAP. Precipitation statistics will be evaluated using a model which incorporates temporal and spatial precipitation data. Non-linear chemistry will be evaluated using an atmospheric chemistry model. Statistical techniques will be utilized to evaluate relative significance of input parameters to the uncertainty of these atmospheric processes, and to aggregate the effect of each of these processes into total assessment-model uncertainty.

29225 **(UCRL—89964-Rev.1) Response to W.W. Kellogg "Carbon Dioxide and Climatic Change: Implications for Mankind's Future". Rev.1.** Ellseasser, H.W. (Lawrence Livermore National Lab., CA (USA)). Feb 1984. Contract W-7405-ENG-48. 22p. (CONF-8311100—1-Rev.1). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE84010986.

From 12. international conference on global environmental problems; Chicago, IL, USA (24 Nov 1983).

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Three points are made: (1) the contemporary practice of developing consensus views through committees of experts tends more to harden the consensus than to solve or deepen understanding of the problem, (2) the effects cascade tends to appear for more ominous when presented in isolation than when viewed from the receiving end as only one of the many impacting factors, (3) there are valid reasons for questioning the prevailing estimate of 3 +- 1.5°C warming for doubled CO_2. 39 references.

29226 **Application of internal standards in routine vapor measurements by gas chromatography.** Schirmer, R.E.; Pahl, T.R.; Phelps, D.W. (Battelle Pacific Northwest Lab., Richland, WA). *American Industrial Hygiene Association Journal;* **45**: No. 2, 95-98(Feb 1984).

The use of an internal standard supplied from a diffusion source is advantageous in maintaining calibration and diagnosing operating problems in gas chromatographs used for routine, on-line monitoring of organic vapors. A system designed for monitoring vapors generated for inhalation toxicolgy studies is described.

29227 **Litterfall sulfur and nitrogen inputs as influenced by power plant proximity.** Kelly, J.M. (Tennessee Valley Authority, Oak Ridge). *Water, Air, and Soil Pollution;* **22**: No. 2, 143-152(Feb 1984).

The mass of litterfall input, and its weight and concentration of S and total N, were evaluated over a 3 yr period at two locations on the Cumberland Plateau in Tennessee to determine if proximity to a major coal-fired power plant would have a significant impact on elemental input to the forest floor via littefall. Higher levels of atmospheric S and N input have been reported for the Cross Creek site versus the Camp Branch location. As a general rule, the mass of litterfall and the amount of S and N transferred from standing biomass to the forest floor by litterfall did not differ in a statistically significant manner as a function of year, cover type, or location. The limited number of significant responses which were observed were confined for the most part to a single cover type and were attributed to factors other than atmospheric inputs. These and other data collected from the same sites indicate that at least for the elements evaluated, no statistically significant effect on litterfall S and N due to local emissions could be detected.

29228 **Mesoscale spatial variability of sulfate in air and rainwater at St. Louis.** Bridgman, H.A. (Telinois State Water Survey, Urbana). *Water, Air, and Soil Pollution;* **22**: No. 2, 153-172(Feb 1984). Contract AC02-76EV01199.

Sulfate concentrations in rain water and in air measured on four summer days at St. Louis were highly variable, both spatially or temporally. Maximum/minimum ratios of aerosol SO_4/sup =/ varied by up to a factor of 9, and those in rain water by a factor of 3 on the average. Generally, SO_4/sup =/ concentration patterns in air and rain water were similar, and consistent with wind direction and the location of sources. Direct relationships between SO_4/sup =/ in air and in water were evident on two of the individual days, but not for all days together. The non-uniformity of the SO_4/sup =/ pattern plus consideration of possible sources of SO_4/sup =/ suggests that nucleation of SO_4/sup =/ particles must be a major cause of S scavenging, with some possible influence from sub-cloud impaction.

29229 **Indoor-air-quality research. Hearings before the Subcommittee on Energy Development and Applications and the Subcommittee on Natural Resources, Agriculture Research and Environment, US House of Representatives, Ninety-Eighth Congress, first session, August 2, 3, 1983.** Washington, DC; Government Printing Office (1984). 508p. GPO.

Spokesmen for the environmental health sciences, consumer product safety, medical profession, and conservation discussed current research on whether indoor air quality suffers as a result of weatherization to reduce air leakage at a two-day hearing. Critical areas for research were the identification, measurement, characterization, control and health effects of indoor pollutants. Of particular concern to the committee was the administration's phasing out of some research programs despite DOE authorization and Congressional appropriations to continue. The witnesses discussed contaminants from building materials, household products, and other sources as well as the effects of reduced ventilation. Additional material submitted for the record follows their testimony.

29230 **Atmospheric sulfur deposition, neutralization, and ion leaching in two deciduous forest ecosystems.** Richter, D.D.; Johnson, D.W.; Todd, D.E. (Oak Ridge National Lab., TN). *Journal of Environmental Quality;* **12**: No. 2, 263-270(Apr-Jun 1983). Contract W-7405-ENG-26.

In the 1981 water year, bulk precipitation was primarily a solution of dilute H_2SO_4, and SO_4^{2-} was the dominant anion in throughfall and soil leachates in two eastern Tennessee deciduous forests. Ecosystem inputs of SO_4^{2-}, which included dry deposition of forest canopies, may have been up to 40% greater than input estimates based on atmospheric deposition sampling in open areas. Volume-weighted mean annual pH of bulk precipitation was 4.3; of throughfall 4.8; and of leachates from O2, A1, and B21 soil horizons about 6.0. At both sites, strong acids in precipitation were largely neutralized prior to rainfall's infiltration into mineral soil. Base cations that exchanged with H^+ (hydrogen ions) in acid precipitation were almost entirely supplied by forest canopies and litter layers, and did not come directly from exchangeable mineral soil pools. Inputs of H^+ from acid precipitation were equal to about 0.4% of the base cations that are biologically cycling and immediately available in these ecosystems. Although poorly quantified, mineral weathering and deep rooting will supply, over time, substantial amounts of additional base cations for biologic cycling. Both soils are base-poor Udults and classified as sensitive to acid rain, but the deposition, cycling, and soil data presented in this report indicate that leaching remains a process affecting cation reserves and soil development only over the very long term.

29231 **Chemiluminescent detection of reduced sulfur compounds with ozone.** Kelly, T.J.; Gaffney, J.S.; Phillips, M.F.; Tanner, R.L. (Brookhaven National Lab., Upton, NY). *Analytical Chemistry;* **55**: No. 1, 135-138(Jan 1983). Contract AC02-76CH00016.

A method is described for the chemiluminescent detection of H_2S, dimethyl sulfide (DMS), and other reduced sulfur compounds at the sub-ppB levels by their oxidation with ozone. At sulfur concentrations of < 100ppB, the emission intensity was found to be first order with respect to sulfide, and the calibration plots were linear. At higher concentrations (500ppB) of H_2S, a reaction order of 0.5 was noted. Detection limits for H_2S, DMS, CH_3SH, and thiophene of about 4, 0.3, 0.1, and 12 ppB, respectively were determined. The interference of various substances (e.g. hydrocarbons, NO, NO_2, acetaldehyde, and SO_2) on the determination of reduced sulfur compounds is reported.

29232 **Formaldehyde release from simulated wall panels insulated with urea-formaldehyde foam insulation.** Hawthorne, A.R.; Gammage, R.B. (Oak Ridge National Lab., TN). *Journal of the Air Pollution Control Association;* **32**: No. 11, 1126-1131(Nov 1982). Contract W-7405-ENG-26.

An important potential source of formaldehyde in the home is urea-formaldehyde foam insulation (UFFI). This study measures the long-term release of formaldehyde through the interior wall of test panels foamed with commercial urea-formaldehyde insulation. The measurements, made approximately 16 mo after initial foaming, were conducted under both static and dynamic air conditions with air flow selected to simulate a typical air exchange found in houses. Estimated room concentration based on a simple model of uniform mixing within a room and measured emission rates are presented. Measurements of formaldehyde in the air from within the UFFI cavities are also reported.

5003 Radioactive Materials Monitoring And Transport

REFER ALSO TO CITATION(S) 27968, 27983, 28590, 29139, 29277, 29278

29233 (ANL—83-100-Pt.2, pp 77-82) **Rare earth aerosol analysis by XRF.** Citron, I.M.; Mausner, L.F. Mar 1984. NTIS, PC A09/MF A01. Order Number DE84008870. TI84008870

In Environmental Research Division annual report: Center for Human Radiobiology, July 1982-June 1983.

An analytical method utilizing x-ray fluorescence (XRF) spectrometry is described to determine simultaneously the amounts of lanthanum, cerium, praseodymium, and neodymium in air-filter samples collected at a rare-earth processing refinery in Illinois.

29234 **(CONF-840407—1) Comparison of observed and predicted Kr-85 air concentrations.** Yildiran, M.; Miller, C.W. (Oak Ridge National Lab., TN (USA)). 25 Apr 1984. Contract AC05-84OR21400. 14p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE84011628.

From International symposium on the biosphere; Miami Beach, FL, USA (16 Apr 1984).

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A computer code, ANEMOS has been written to estimate concentrations in air and ground deposition rates for Atmospheric Nuclides Emitted from Multiple Operation Sources. This code uses a modified Gaussian plum equation. Output from ANEMOS includes annual-average air concentrations and ground deposition rates of dispersed radionuclides and daughters. To use the environmental transport model properly, some estimate of the models predictive accuracy must be obtained. To validate the ANEMOS model, one year of weekly average Kr-85 concentrations observed at 13 stations located 28 to 144 km distant from continuous point source at the Savannah River Plant (SRP), Aiken, South Carolina, have been used. There was a general tendency for the model to underpredict the observed air concentrations slightly. Pearsons's correlation between pairs of logarithms of observed and predicted annual-average values was r = 0.84. The monthly results tend to show more scatter than do either the seasonal or the annual comparisons. 18 references, 3 figures, 3 tables.

29235 **(DOE/PN/00292—T4) 1983 annual environmental report, Radiological. Volume 2. Duquesne Light Company, Beaver Valley Power Station, and Shippingport Atomic Power Station.** (USDOE Pittsburgh Naval Reactors Office, West Mifflin, PA). 1983. Contract AC11-76PN00292. 125p. NTIS, PC A06/MF A01; 1; GPO Dep. Order Number DE84011600.

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This report describes the Radiological Environmental Monitoring Program conducted during 1983 in the vicinity of the Beaver Valley Power Station and the Shippingport Atomic Power Station. The Radiological Environmental Program consists of on-site sampling of water and gaseous effluents and off-site monitoring of water, air, river sediments, soils, food pathway samples, and radiation levels in the vicinity of the site. The results of this environmental monitoring program show that Shippingport Atomic Power Station and Beaver Valley Power Station operations have not adversely affected the surrounding environment. 23 figures, 17 tables.

29236 **(DPSP—60-25-25) SRP radioactive waste releases: startup through 1959.** Ashley, C. (Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Plant). Sep 1980. Contract AC09-76SR00001. 8p. NTIS, PC A02; 3; GPO Dep. Order Number DE84012427.

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This report summarizes and documents radioactive waste releases to the environs of the Savannah River Plant from startup through 1959. During this period, the quantity of beta-emitting radioisotopes released was determined by a total or gross analysis.

29237 **(DPSP—62-25-5) 1961 audit of SRP radioactive waste.** Ashley, C. (Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Plant). Sep 1962. Contract AC09-76SR00001. 13p. NTIS, PC A02; 3; GPO Dep. Order Number DE84012429.

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This report summarizes releases of radioactive waste to the environs of the Savannah River Plant during the calendar year 1961. Total quantities of radioactive waste released from Plant startup through 1961 are also reported. 4 tables.

29238 **(DPSP—63-25-1) 1962 audit of SRP radioactive waste.** Ashley, C. (Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Plant). May 1963. Contract AC09-76SR00001. 15p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE84012430.

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This report summarizes releases of radioactive waste to the environs of the Savannah River Plant during the calendar year 1962. Total quantities of radioactive waste released from Plant startup through 1962 are also reported. Total quantities of radioactive waste released to the atmosphere, to effluent streams, and to earthen seepage basins during 1962 and during the nine-year period from Plant startup through 1962 are presented. 4 tables.

29239 **(DPSP—64-25-1) 1963 audit of SRP radioactive waste.** Ashley, C. (Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Plant). May 1964. Contract AC09-76SR00001. 17p. NTIS, PC A02; 3; GPO Dep. Order Number DE84012423.

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This report summarizes releases of radioactive waste to the environs of the Savannah River Plant during the calendar year 1963. Total quantities of radioactive waste released from Plant startup through 1963 are also reported. 4 tables.

29240 **(DPSP—65-25-1) 1964 audit of SRP radioactive waste.** Ashley, C. (Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Plant). Apr 1965. Contract AC09-76SR00001. 17p. NTIS, PC A02; 3; GPO Dep. Order Number DE84012428.

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This report summarizes releases of radioactive waste to the environs of the Savannah River Plant during the calendar year 1964. Total quantities of radioactive waste released from Plant startup through 1964 are also reported. 4 tables.

29241 **(MLM—3143) Environmental monitoring at Mound: 1983 report.** Carfagno, D.G.; Farmer, B.M. (Monsanto Research Corp., Miamisburg, OH (USA). Mound). 25 Apr 1984. Contract AC04-76DP00053. 49p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE84012991.

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The environment locally surrounding Mound was monitored primarily for tritium and plutonium-238. The results are reported for 1983. Environmental mediums analyzed included air, water, vegetation, foodstuffs, and sediment. The average concentrations of plutonium-238 and tritium were within the applicable standards for radioactive species. Data concerning the emission of nonradioactive species into the atmosphere are also presented. All emissions were 9% or less of the applicable emissions standard. 16 references, 5 figures, 30 tables.

29242 **(PB—84-145796) Unattached radon daughter atoms and radon daughter equilibrium ratios in uranium mines. Final report.** Holaday, D.A. (National Inst. for Occupational Safety and Health, Cincinnati, OH (USA)). 29 Jun 1972. 12p. NTIS, PC A02/MF A01.

Uranium mines in Colorado and New Mexico were surveyed for airborne concentrations of radon (10043922) and radon daughters. A procedure for measuring individual daughters and the fraction of each existing as free atoms was developed and used for field monitoring. Samples were taken in working areas and particle counts were made. The data was analyzed to determine the ratio of radon to radon daughters as well as the ratios among the radon daughters. The author concludes that since the radon to working level ratios have not changed much in 20 years, using the ratio as the basis for estimating relative biological hazard is just as uncertain now as then. The large number of daughters present as free atoms indicate that the lung radiation doses calculated using any of the lung models need reexamination.

29243 **(PB—84-150192) Evaluation of radon sources and phosphate slag in Butte, Montana.** Lloyd, L.L.; O'Connell, M.F. (Montana Dept. of Health and Environmental Sciences, Helena (USA)). Jun 1983. 87p. NTIS, PC A05/MF A01.

In July, 1980, the Montana Department of Health and Environmental Sciences (DHES) contracted with the EPA to further investigate the potential sources of radon in Butte. Under the agreement with EPA, surface geological constitutes, air, water and natural gas supplies, and building materials were investigated as potential radon sources. Following the investigation of potential radon sources in Butte, it was concluded that ambient air, soils and surface geology all contribute to Butte's radon problem. It is believed that homes constructed over major factures or mineralized veins are the most severely impacted. Aplite and quartz monzonite also contribute to the problem, but to a lesser extent. Ambient air is probably a major source of indoor radon in structures having low concentrations.

29244 **(PNL—5038) Environmental surveillance at Hanford for CY 1983.** Price, K.R.; Carlile, J.M.V.; Dirkes, R.L.; Trevathan, M.S. (Pacific Northwest Lab., Richland, WA (USA)). May 1984. Contract AC06-76RL01830. 90p. NTIS, PC A05/MF A01; GPO Dep. Order Number DE84012888.

Environmental surveillance activities performed by the Pacific Northwest Laboratory for the Department of Energy's Hanford Site for 1983 are discussed in this report. Samples of environmental media were collected in support of the Hanford Environmental Surveillance Program to determine radionuclide concentrations in the Hanford environs. Radiological impacts in terms of radiation dose equivalents as a result of Hanford Operations are also discussed. Radionuclide concentrations in air, Columbia River water, ground water, foodstuffs, wildlife, soils, and vegetation are presented. Measurements were also made of external penetrating radiation and nonradiological water quality. An assessment of potential radiological impacts attributable to 1983 operations at Hanford indicated that radiation doses to the public were well below all applicable regulatory limits, and significantly less than doses potentially received from other common sources of radiation. 35 references, 16 figures, 59 tables.

29245 **(PNL-SA—11679) Computer simulation of time-of-event counting data for measurement of ultra low levels of radioactivity.** Kaye, J.H.; Kinnison, R.R. (Pacific Northwest Lab., Richland, WA (USA)). Apr 1984. Contract AC06-76RL01830. 11p. (CONF-840408—14). NTIS, PC A02/MF A01; GPO Dep. Order Number DE84011877.

From 5. international conference on nuclear methods in environmental and energy research; Mayaguez, Puerto Rico (2 Apr 1984).

Time-of event counting is a method for measuring very low levels of short-lived radionuclides. This method records the time at which each counting event of interest occurs. It was desired to compare this counting method with more conventional grouped-data counting methods in which a scaler or pulse-height analyzer is operated in recycle mode with printout of the counting data after each cycle. However, since this would be very difficult to do experimentally with sufficient statistical accuracy, a method for simulation of the required low-level counting data was developed. The simulation program and its use for evaluation of the time-of-event counting method will be discussed. 3 references, 3 figures, 4 tables.

29246 **(TVA/PUB—84/38) Environmental radioactivity levels Bellefonte Nuclear Plant. Annual report, 1983.** (Tennessee Valley Authority, Muscle Shoals, AL (USA). Radiological Health Staff). May 1984. 52p. NTIS, PC A04/MF A01. Order Number DE84901241.

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The Bellefonte Nuclear Plant (BLN), being constructed by the Tennessee Valley Authority, is located in Jackson County, Alabama. The plant will consist of two pressurized water reactors; each unit is rated at 3620 MWt and 1271 MWe. Fuel load in unit 1 is scheduled for no earlier than 1987. A preoperational environmental radiological monitoring program was implemented in August 1978. This program has the objective of establishing a baseline of data on the distribution of natural and manmade radioactivity in the environment near the plant site. This report presents the results obtained from that program during 1983. Since BNL has not achieved criticality, there has been no contribution of radioactivity to the environment from the operation of the plant. The levels of radioactivity are due to natural background radiation, fallout from nuclear weapons testing, or other nuclear operations in the area. 9 figures, 30 tables.

29247 **(USGS—474-318) Tritium concentrations measured in samples of precipitation and streams in 1963 and 1964.** Beetem, W.A.; Grove, D.B. (Geological Survey, Denver, CO (USA)). Apr 1984. Contract AI08-76DP00474. 12p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE84011159.

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Tritium data obtained by various laboratories are tabulated annually by the International Atomic Energy Agency. In addition each of the laboratories doing concentration determinations of naturally occurring tritium summarize their data intermittently. This report presents graphically the seasonal variations and geographical distribution patterns for 1963 and 1964 obtained for precipitation and streams by the US Geological Survey. The highest recorded tritium concentration in 1964 in precipitation in the United States was 41.4×10^{-6} μc/ml at the Denver Station. The greatest range in concentrations in precipitation for 1964 of 38.3×10^{-6} μc/ml also was recorded at this station. At network stations concentrations of tritium in streams in 1964 ranged from an average of 0.3×10^{-6} μc/ml in the Kissimmer River in Florida to 4.9×10^{-6} μc/ml in the Colorado. 10 references, 4 figures, 1 table.

29248 **(WINCO—1002) ICPP effluent monitoring report, 4th quarter CY-1983.** (Westinghouse Idaho Nuclear Co., Inc., Idaho Falls (USA)). Feb 1984. Contract AC07-84ID12435. 61p. NTIS, PC A04; 3; GPO Dep. Order Number DE84010301.

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This report summarizes the data collected by effluent and environmental monitoring programs conducted at the Idaho Chemical Processing Plant. During the fourth quarter of 1983, 1.04E+03 curies of activity were disposed of from ICPP operations. Airborne effluent releases to the atmosphere contributed approximately 1.02E+02 curies; liquid effluent releases through the disposal well contributed 1.34E+01 curies; and solid waste shipped to the Radioactive Waste Management Complex (RWMC) contained 9.23E+02 curies. Year-to-date releases totaled 5.27E+03 curies; 3.75E+03 curies from airborne releases, 4.36E+02 curies in liquid effluents and 1.08E+03 curies in solid waste. 27 figures, 10 tables.

29249 **Rapid determination of noble gas radionuclide concentrations in power reactor plumes.** Gogolak, C.V. (Dept. of Energy, New York, NY). *Health Physics;* **46**: No. 4, 783-792(Apr 1984).

Calibration procedures and measurement protocols are described for taking in situ high resolution γ-ray spectra in the vicinity of nuclear installations. These spectra can be analyzed to calculate the release rates, the ground-level air concentrations and the resultant exposure rates for individual radionuclides in the effluent plume. Standard Gaussian cloud concentration models are used for the source geometry and the methods may be readily adapted to existing spectrometer systems. An example application of the method to a γ-ray spectrum taken near a large boiling water reactor BWR is presented.

29250 **CRRIS: a computerized system to assess atmospheric radionuclide releases.** Baes, C.F. III; Miller, C.W. (Oak Ridge National Lab., TN). *Nuclear Safety;* **25**: No. 1, 75-85(Jan-Feb 1984).

The Computerized Radiological Risk Investigation System (CRRIS) consists of six integrated computer codes that stand alone or are run as a system to calculate environmental transport, doses, and risks from atmospheric radionuclide releases. PRIMUS output provides to other CRRIS codes the capability to handle radionuclide decay chains. ANEMOS and RETADD-II calculate atmospheric dispersion for local (≦ 80 km) and regional (> 80 km) distances, respectively, and output annual-average air concentrations

and ground deposition rates. Multiple ANEMOS Runs for sources within a small area are combined on a master grid by SUMIT. TERRA calculates food-chain transport, and ANDROS calculates individual or population exposures, doses, and risks. Integral to CRRIS are computerized upper-air wind, climatological, agricultural, land use, demographic, decay, and dosimetric data bases. It is expected that CRRIS may be used by the Environmental Protection Agency in determining compliance with the Clean Air Act for radionuclides released from Department of Energy facilities and facilities licensed by the Nuclear Regulatory Commission.

5004 Thermal Effluents Monitoring And Transport

REFER ALSO TO CITATION(S) 29329

5006 Regulations

REFER ALSO TO CITATION(S) 28510

29251 **(PB—84-147453) Control technology alternatives and costs for compliance: elemental phosphorus plants. Final report.** Stula, R.T.; Kirstein, B.E.; Redding, R.T.; deLesdernier, D.L.; Horton, W.F. (Science Applications, Inc., La Jolla, CA (USA)). 1 Dec 1983. 109p. NTIS, PC A06/MF A01.

On April 6, 1983, the United States Environmental Protection Agency (EPA) proposed a standard under Section 112 of the Clean Air Act limiting airborne polonium-210 emissions for calciner operations at domestic elemental phosphorus plants to 1 Ci/yr. To evaluate the effect of the proposed standard, physical and chemical properties of polonium through plant processes assessed. Results indicate that polonium is volatilized from phosphate ore during calcining and, for the most part, deposited on fine particulates leaving the process. Projected emissions for each elemental phosphorus plant were determined using available data, and the uncertainty associated with each estimated release was evaluated. After taking into account this uncertainty, two plants were determined to exceed the proposed limiting standard for airborne polonium emissions. One plant was found in borderline compliance. Emission control alternatives are proposed for the three plants. Cost estimates associated with each proposed alternative are provided.

51 ENVIRONMENTAL SCIENCES, TERRESTRIAL

REFER ALSO TO CITATION(S) 30094

5101 Basic Studies

REFER ALSO TO CITATION(S) 29274

29252 **(CONF-8404144—1) Stochastic model for estimation of environmental density.** Janardan, K.G.; Uppuluri, V.R.R. (North Dakota State Univ., Fargo (USA); Oak Ridge National Lab., TN (USA)). 1984. Contract AC05-84OR21400. 9p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE84011657.

From Modeling and simulation conference; Pittsburgh, PA, USA (19 Apr 1984).

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The environment density has been defined as the value of a habitat expressing its unfavorableness for settling of an individual which has a strong anti-social tendency to other individuals in an environment. Morisita studied anti-social behavior of ant-lions (Glemuroides japanicus) and provided a recurrence relation without an explicit solution for the probability distribution of individuals settling in each of two habitats in terms of the environmental densities and the numbers of individuals introduced. In this paper the recurrence relation is explicitly solved; certain interesting properties of the distribution are discussed including the estimation of the parameters. 4 references, 1 table.

29253 **(LA-UR—84-1399) Prediction of soil loss with the CREAMS model.** Becker, N.M. (Los Alamos National Lab., NM (USA)). 24 Jul 1984. Contract W-7405-ENG-36. 10p. (CONF-840744—1). NTIS, PC A02/MF A01; GPO Dep. Order Number DE84011365.

From American Society of Civil Engineers Irrigation and Drainage Div. specialty conference; Flagstaff, AZ, USA (24 Jul 1984).

Variations in soil loss as a function of certain land use and land management practices were investigated on a small watershed in the Texas Panhandle using CREAMS, a recently developed computer model capable of simulating dynamic rainfall, runoff, and erosion processes over the time-frame of decades. Simulations of different curve numbers, three types of cropping, and varying crop yield and plowing practices were made to determine the sensitivity of soil loss to these parameters. Comparisons were made to actual in-field measurements of soil loss on experimental plots. 8 references, 3 figures.

29254 **(PB—84-155662) Five southern California oaks: identification and postfire management. Forest service general technical report (final).** Plumb, T.R.; Gomez, A.P. (Forest Service, Berkeley, CA (USA). Pacific Southwest Forest and Range Experiment Station). Oct 1983. 62p. NTIS, PC A04/MF A01.

Oak trees in California are subject to periodic burning by fire, but their trunks and crowns vary in tolerance to fire. And once burned, oaks are difficult to identify by species. Fifteen oak species grow in California. This report provides keys to identifying five species of southern California oaks: coast live oak (Quercus agrifolia), interior live oak (Q. wislizenii) California black oak (Q. kelloggii), canyon live oak, (Q. chrysolepis), and California scrub oak (Q. dumosa).

29255 **(PB—84-155944) Status of exotic woody species in big cypress national preserve. Technical report.** Gunderson, L.H. (Everglades National Park, Homestead, FL (USA). South Florida Research Center). Dec 1983. 35p. NTIS, PC A03/MF A01.

The current status of exotic woody plants in Big Cypress National Preserve is documented. A map of the distribution of principal pest species, Melaleuca quinquenervia, Schinus terebinthifolius, and Casuarina sp., is presented. Prognoses of population increases of these problem species are determined utilizing the current distributions and assessing environmental conditions. Some potential problem species are also identified.

29256 (PNL—5000-Pt.2, pp 3-11) **Western semi-arid ecosystems.** Feb 1984. NTIS, PC A04/MF A01. Order Number DE84007998. TI84007998

In Pacific Northwest Laboratory annual report for 1983 to the DOE Office of Energy Research. Part 2. Ecological sciences.

One goal of the semi-arid ecosystems research program is to find ways to detect deleterious changes in ecosystems while the changes are still small. A second goal is to provide and maintain field facilities such as the National Environmental Research Park (NERP) for extramural scientists doing environment research of interest to the DOE. A large data base for use in characterizing biotic communities; successional processes, transport pathways and ecosystem responses to natural and man-induced perturbations has been developed. Specific studies conducted during 1983 include NERP projects (elk population study, forage range include of nesting barriers, impact of river level fluctuation on birds, sensitivity of salt-tolerant shrubs to wildfire, use of harvest ants to detect soil contaminants and forage behavior of small animals relative to larger animals); detecting ecological change (measurement of bitterfall, herm colonies as biological indicators, stress detection in plants and the vulnerability of steelhead vs trout to dewarting) and ecological investigations in Alaska. 7 figures.

29257 **Field energetics and foraging mode of Kalahari lacertid lizards.** Nagy, K.A.; Huey, R.B.; Bennett, A.F. (Univ. Of California, Los Angeles). *Ecology;* 65: No. 2, 588-596(Apr 1984). Contract AC03-76SF00012.

The authors examined the energetic costs associated with foraging mode in the widely foraging lizard Eremias lugubris (mean mass 3.83 g) and the sit-and-wait lizard Eremias lineoocellata (3.27 g). These lizards are broadly sympatric in the Kalahari desert. The widely foraging species had significantly higher field metabolic rates (800 vs. 544 J/d, as measured with doubly labeled water), feeding rates (metabolizable energy of 1165 vs. 739 J/d), production rates (365 vs. 195 J/d) and water influx rates (0.285 vs. 0.156 mL/d). Measurements were made before the reproductive season began; there were no significant differences in these measures between sexes within either species. Resting metabolic rates (measured as O_2 consumed) were similar at 37°C (0.240 vs. 0.252 mL g^{-1} H^{-1}) and 26° (0.094 vs. 0.103 mL g^{-1} h^{-1}), the field active and nocturnal burrow temperatures respectively, of both species. Field metabolic rates, on a 24-h basis, were 3.1 x resting in E. lugubris and 2.2 x resting in E. lineoocellata. Energy expenditures during the activity period were 12.0 x resting in the wide forager and 2.8 x resting in the sit-and-wait predator. Foraging efficiency (metabolizable energy gained while foraging/total energy spent while foraging) was higher in the wide forager (2.0 than in the sit-and-wait predator. The wide forager grew nearly twice as fast as did the sit-and-wait predator during this study. On an annual basis, variation in food availability or differences in predation rate may alter the relative fitness of these foraging modes.

5102 Chemicals Monitoring And Transport

REFER ALSO TO CITATION(S) 29188, 29204, 29208, 29212, 29230, 29273, 29312, 29498, 29501, 29502

29258 (EPRI-EL—3345) PCB removal from transformers. Final report. Osborn, S.W.; Iaconianni, F.J.; Saggiomo, A.J.; Landau, P.A.; Biordi, J.C. (Franklin Research Center, Philadelphia, PA (USA)). May 1984. 94p. EPRI-RRC, Box 50490, Palo Alto, CA 94303. Order Number DE84920350.

A method is described for the extractive removal of PCBs from mineral oil dielectric fluids using polyethylene glycol solvents as the primary extraction media, followed by re-extraction of the polar liquids using a volatile secondary solvent from which the primary solvent can be recovered for reuse and the PCBs concentrated for ultimate disposal by incineration or chemical destruction. A method is further described for the adsorptive removal of PCBs from lightly-contaminated oils which could be developed into a rapid and convenient field purification method for these dielectric oils.

29259 (FWS/OBS—80/40.17) Rocky Mountain acidification study. Gibson, J.H.; Galloway, J.N.; Schofield, C.; McFee, W.; Johnson, R.; McCarley, S.; Dise, N.; Herzog, D. (Fish and Wildlife Service, Kearneysville, WV (USA). Eastern Energy and Land Use Team). Oct 1983. 153p. NTIS, PC A08/MF A01. Order Number DE84901174.

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The objectives of this report were to determine the sensitivity of watersheds characteristic of the Rocky Mountain Region and the relationship of watershed sensitivity to geology and soils; to evaluate the extent of current acidification and the potential for increasing acidification with increasing deposition of nitrate and sulfate; to evaluate the results of the preceding in terms of impacts on fish populations; and to develop recommendations for assessment of future trends in both changing water chemistry and impacts on fish populations. Areas selected for study included the Rocky Mountain National Ppark and Yellowstone National Park, exemplifying two different geologic types that are representative of a large portion of the Rocky Mountain region. Rocky Mountain National Park is primarily underlain by granite and Yellowstone National Park by volcanic materials. Sensitivity is primarily determined by bedrock geology and varies inversely with elevation. High-elevation lakes and streams in the central Rocky Mountain region are very sensitive to acidic deposition. With respect to fish populations there is currently no evidence of chronic acidification and thus no apparent impact on fisheries. However, the very low base cation concentration observed in the headwater drainages of Rocky Mountain National Park suggests extreme sensitivity to acidification. Waters in volcanic areas such as Yellowstone National Park are generally of high alkalinity and do not represent potentially sensitive habitats. 109 references. 31 figures, 24 tables.

29260 (ORNL/TM—8857) Worldwide organic soil carbon and nitrogen data. Zinke, P.J.; Stangenberger, A.G.; Post, W.M.; Emanuel, W.R.; Olson, J.S. (Oak Ridge National Lab., TN (USA)). May 1984. Contract AC05-84OR21400. 146p. NTIS, PC A07/MF A01; GPO Dep. Order Number DE84012041.

A compilation of soil carbon and nitrogen storage data for more than 3500 soil profiles from under natural vegetation or relatively undisturbed sites is presented in this report. A summary table of the carbon and nitrogen storage in a pedon of surface cubic meter for each soil profile, as well as location, elevation, climate, parent material, and vegetation information, are presented. The data were used to determine average carbon and nitrogen storage on land surfaces of the world. Calculations were also made of storage related to climatic classifications, ecosystem clasifications, and latitudinal increments from the equator to 75°. Carbon ($kg.m^{-3}$) varies from 2 in hot dry climates, through 10 in many cold dry or seasonally moist (warm or hot) climates, to more than 30 in wet alpine or subpolar climates. Nitrogen storage, an order of magnitude smaller than carbon storage in soils, shows broad parallels but exceeds 1600 $g.m^{-3}$ for subtropical/tropical premontane or lower montane soils, as well as alpine or subpolar wet soils. Such limiting conditions, defined by a balance of income and loss rates for mature soil profiles, also explain much of the variation among major ecosystem complexes whose soils are partly disturbed, incompletely recovered, or imperfectly known regarding their maturity and stability. Classifying profiles into Holdridge life zones and using appropriate life zone areas, we estimate 1309 x 10^{15} g carbon and 92 x 10^{15} g nitrogen in the world's soils. Alternatively, using average organic carbon and nitrogen densities from one degree latitude bands multiplied by the earth's surface area in the respective bands, we arrive at 1728 x 10^{15} g of carbon and 117 x 10^{15} g of nitrogen. Inadequacies that lead to the disparate estimates are discussed. 123 references, 5 figures, 7 tables.

29261 (PB—84-148972) Genetic engineering and the development of new pollution control technologies. Final report. Johnston, J.B.; Robinson, S.G. (Illinois Univ., Urbana (USA). Inst. for Environmental Studies). Jan 1984. 143p. NTIS, PC A07/MF A01.

This report relates genetic engineering and biological waste treatment, so that opportunities for its improvement can be identified and evaluated. It describes the state of development of gene manipulation and natural limits to biodegradation as of early 1983. It identifies a number of research topics that are likely to contribute to new pollution treatment techniques. These include the basic mechanisms underlying microbical co-metabolism and oligotrophy; molecular genetics in filamentous fungi, in strict anaerobes and in archaebacteria; directed evolution of enzymes and metabolic pathways; and studies to advance understanding of dehalogenations by microbes.

29262 (PB—84-153444) Coal mine related stream sediment geochemistry in southern Illinois. Technical report 1975-81. Hood, W.C.; Robinson, P.D.; Chruscicki, J.B.; Delfino, T.A. (Southern Illinois Univ., Carbondale (USA)). Feb 1984. 123p. NTIS, PC A06/MF A01.

A regional survey in stream sediment geochemistry indicates that downstream areas from coal mines or coal related land uses can contain four times the median value of several elements, specifically cadmium, cobalt, copper, iron, manganese, nickel and zinc. In those parts of a mine-impacted stream where low pH is maintained, metals can be leached from the stream sediment to further increase the concentrations in water. This phenomenon is significant to watershed managers and potential downstream water users in that they can begin to analyze their water quality problems.

29263 (PB—84-158807) Design and development of a hazardous waste reactivity testing protocol. Final report, Jun 82-Aug 83. Wolbach, C.D.; Whitney, R.R.; Spannagel, U.B. (Acurex Corp., Mountain View, CA (USA). Energy and Environmental Div.). Feb 1984. 155p. NTIS, PC A08/MF A01.

A test protocol to determine the gross chemical composition of waste materials has been developed for use at uncontrolled haz-

ardous waste sites. Included is a field test kit, flow diagrams, a descriptive manual and a mixing device to observe the effects of mixing two hazardous wastes. Prior knowledge of the chemical composition of the waste materials is not required for this protocol. Unidentified wastes were classified by reactivity groups using this test scheme in the laboratory and in the field. Small amounts of wastes that indicated compatibility were placed in the mixing device to verify that mixing would not generate immediate catastrophic results.

29264 (PNL—5000-Pt.2, pp 17-24) **Mobilization, fate and effects of chemical wastes.** Feb 1984. NTIS, PC A04/MF A01. Order Number DE84007998. TI84007998

In Pacific Northwest Laboratory annual report for 1983 to the DOE Office of Energy Research. Part 2. Ecological sciences.

A number of energy technologies produce large volumes of liquid and solid wastes. The composition of these wastes will differ between and even within technologies, and both inorganic and organic chemical compounds are of concern. Environmental pathways for transport, transformation and accumulation of these compounds often result in the potential exposure of people to toxic materials. We have made progress in recent years in delineating the major environmental routes for such exposure. However, the current state-of-the-art does not yet permit an adequate evaluation of the relative importance of many detailed processes known to affect transport and transformation of solutes, or the biological availability, uptake and metabolism of particular chemical forms of these contaminants. The current program is conducted in three parts. We are studying hydrogeochemical processes governing transport, chemical uptake and metabolism by green plants, and chemical uptake and metabolism by aquatic organisms (fish and shellfish). The program focuses particularly on commonalities in abiotic and biotic processes controlling chemical transport and effects.

29265 **Nutrient budgets and internal cycling of N, P, K, Ca, and Mg in conventional tillage, no-tillage and old-field ecosystems on the Georgia piedmont.** Stinner, B.R.; Crossley, D.A. Jr.; Odum, E.P.; Todd, R.L. (Univ. of Georgia, Athens). *Ecology;* **65**: No. 2, 354-369(Apr 1984).

Nutrient budgets (N, P, K, Ca, and Mg) were developed for conventional-tillage, no-tillage, and old-field systems. Data for the budgets were collected over a 2-yr period, with grain sorghum as a main season crop followed by a cover crop of winter rye. Nutrient uptake by crops, weeds, and old-field plants was the largest flow in each system. Leaching losses were small compared to input from fertilizer (except for Ca). Leaching losses of N and Ca were greatest in conventional-tillage, followed by no-tillage systems and least in the old field. No significant differences were observed between conventional- and no-tillage systems for leaching losses of P, K, and Mg, although leaching of P and K was significantly less in the old field than in either crop system. No-tillage and old-field systems maintained a larger litter component on the soil surface compared to conventional-tillage systems. Decomposition of litter and subsequent mineralization of nutrients appeared to be more rapid in conventional-tillage systems than in either no-tillage or old-field systems. Insect consumers mobilized a small portion of total nutrient flux within each system. In all three systems, nutrients were retained in litter and plant biomass, not lost through leaching. The chemical concentration of throughfall precipitation appeared to be enriched with ammonium with the exception of the old-filled plant canopy. In all three systems, nitrate concentrations were lower in throughfall compared to incident precipitation. In all three systems, concentrations of P, K, Ca and Mg were higher in throughfall than in incident precipitation. The average pH of throughfall was two units higher than incident precipitation.

29266 **Effects of fly ash on microbial CO_2 evolution from an agricultural soil.** Arthur, M.F.; Zwick, T.C.; Tolle, D.A.; Van Voris, P. (Battelle Columbus Lab., OH). *Water, Air, and Soil Pollution;* **22**: No. 2, 209-216(Feb 1984).

Unweathered, acidic fly ash from a coal-fired power plant was applied to alfalfa meal-amended agricultural soil at levels equivalent to 0, 100, 400, and 700 ton ha^{-1} treatments. Amended soils were placed in respirometer jars and monitored for CO_2-C evolution over a 37-day period. Fly ash applications of 400 and 700 ton ha^{-1} reduced CO_2-C production significantly compared to 0 and 100 ton ha^{-1} treatments. Carbon dioxide-carbon from all treatments was considerably greater than that from soil treated with 1000 ppm $CdCl_2$. The results suggest that soil heterotrophic microbial activity may be impacted minimally by relatively low levels of fly ash application, but may be inhibited by higher levels of fly ash. Several metals were present at potentially toxic levels in the fly ash employed and may have accounted for the inhibition of CO_2-C evolution. The availability of some of these metals was indicated in companion plant uptake experiments.

29267 **Impact of mercury releases at the Oak Ridge complex. Hearing before the Subcommittee on Investigations and Oversight and the Subcommittee on Energy Research and Production, US House of Representatives, Ninety-Eighth Congress, first session, July 11, 1983.** Washington, DC; Government Printing Office (1984). 951p. GPO.

Joseph La Grone, Manager of the Oak Ridge Operations Office of DOE, and spokesmen for the Oak Ridge National Laboratory, the Environmental Protection, the Tennessee Valley Authority, the State of Tennessee, Oak Ridge citizens, and others testified at a one-day hearing on the mercury contamination problem, DOE's response to the problem, and its possible impact on activities at the Y-12 plant. The committee's concern also focused on remedial action and what lessons DOE can learn from the experience. Of major concern to local witnesses was the impact on future growth and development of the city and surrounding area from adverse publicity about the spill. Two appendices with additional material submitted for the record and supplemental questions and answers follow the testimony of 18 witnesses.

29268 **Atmospheric sulfur deposition, neutralization, and ion leaching in two deciduous forest ecosystems.** Richter, D.D.; Johnson, D.W.; Todd, D.E. (Oak Ridge National Lab., TN). *Journal of Environmental Quality;* **12**: No. 2, 263-270(Apr-Jun 1983). Contract W-7405-ENG-26.

In the 1981 water year, bulk precipitation was primarily a solution of dilute H_2SO_4, and SO_4^{2-} was the dominant anion in throughfall and soil leachates in two eastern Tennessee deciduous forests. Ecosystem inputs of SO_4^{2-},which included dry deposition of forest canopies, may have been up to 40% greater than input estimates based on atmospheric deposition sampling in open areas. Volume-weighted mean annual pH of bulk precipitation was 4.3; of throughfall 4.8; and of leachates from O2, A1, and B21 soil horizons about 6.0. At both sites, strong acids in precipitation were largely neutralized prior to rainwater's infiltration into mineral soil. Base cations that exchanged with H^+ (hydrogen ions) in acid precipitation were almost entirely supplied by forest canopies and litter layers, and did not come directly from exchangeable mineral soil pools. Annual fluxes of HCO_3^- alkalinity from B21 horizons, indicated that the natural H^+ input from the partial ionization of H_2CO_3 was of similar magnitude to H^+ input in bulk precipitations in 1981. However, even in these infertile soils with low cation exchange capacities exchangeable bases were more than two orders of magnitude greater than annual H^+ input in bulk precipitation, and represented a substantial reserve for base cations in canopies and litter layers that exchanged with H^+ in acid rain. Furthermore, inputs of H^+ from acid precipitation were equal to about 0.4% of the base cations that are biologically cycling and immediately available in these ecosystems. Although poorly quantified, mineral weathering and deep rooting will supply, over time, substantial amounts of additional base cations for biologic cycling. Both soils are base-poor Udults and classified as sensitive to acid rain, but the deposition, cycling, and soil data presented in this report indicate that leaching remains a process affecting cation reserves and soil development only over the very long term.

5103 Radioactive Materials Monitoring And Transport

REFER ALSO TO CITATION(S) 27973, 27975, 27976, 27978, 29188, 29235, 29236, 29237, 29238, 29239, 29240, 29241, 29244, 29245, 29246, 29248, 29250

29269 **(CEA-CONF—6860) Review of methods for plutonium detection in environment.** Gros, R. (CEA Centre d'Etudes de Bruyeres-le-Chatel, 92 - Montrouge (France)). Jun 1983. 18p. (In French). (CONF-8306170—1). NTIS (US Sales Only), PC A02/MF A01. Order Number DE84750643.

From Congress on plutonium and radioprotection; Saclay, France (14 Jun 1983).

Nuclear properties of plutonium isotopes are briefly recalled and importance of the physico-chemical form on the radioecological behaviour of the radioelement is shown. The different techniques used for environment monitoring are described: measurements on aerosols (with or without chemical separation) by spectrometry with proportional counters or semi-conductors; radiochemical separation associated to alpha spectrometry analysis on the ground with scintillator crystals or semi-conductors; miscellaneous methods (activation, tracks detectors, scintillator crystals in a helicopter.

29270 **(CONF-840408—11) Nondestructive low-energy photon analysis of environmental samples.** Larsen, I.L.; Cutshall, N.H.; Olsen, C.R. (Oak Ridge National Lab., TN (USA)). 1984. Contract AC05-84OR21400. 7p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE84011643.

From 5. international conference on nuclear methods in environmental and energy research; Mayaguez, Puerto Rico (2 Apr 1984).

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Low-energy photons that accompany the decay of alpha- or beta-emitting radionuclides (e.g., ^{241}Am, ^{210}Pb, and ^{238}U-^{234}Th) may be used to quantify concentrations of these radionuclides in environmental samples. Previous attempts to quantify these low-energy photons have had limited success because of the uncertainty associated with photon attenuation in samples of variable matrix composition. A method for directly measuring and applying the self-absorption correction factor is presented. Results obtained by this nondestructive technique for counting low-energy photons are in agreement with values obtained from intracalibrated samples using radiochemical separations and alpha or beta analysis. 8 references, 1 figure, 3 tables.

29271 **(DOE/DP/00539—050) Animal investigation program for the Nevada Test Site: 1957-1981.** Smith, D.D.; Black, S.C. (Environmental Protection Agency, Las Vegas, NV (USA). Environmental Monitoring Systems Lab.). Jan 1984. Contract AI08-76DP00539. 75p. (EPA—600/6-84-020). NTIS, PC A04/MF A01; 1; GPO Dep. Order Number DE84011323.

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This report summarizes the findings of the Animal Investigation Program from its initiation in 1957 to termination in 1981. The Program investigated the effects of nuclear testing at the Nevada Test Site on domestic and wild animals residing on, and in the vicinity of the Test Site. Claims of injury to animals were investigated and a routine program of collecting tissue samples were the principal activities. Tissue samples collected were examined histopathologically and were analyzed for specific radionuclides. Analyses of tissue samples from the Nevada Test Site beef herd occurred semiannually over the entire 25-year period and several other beef herds were analyzed for up to 10-year periods. Other animals sampled for extended periods included mule deer and desert bighorn sheep. The results of the claims investigations are reported as well as analyses for the radionuclides: tritium, strontium-90, iodine-131, cesium-137, and plutonium-239. Also, the results of certain special studies, e.g., in animals around other testing sites such as Mississippi, Colorado, etc., and for special purposes such as at the Rocky Flats Plant in Colorado, and for iodine-129 in thyroids from Nevada cattle are included. Most of the data are presented as trends over time. Calculation of hypothetical doses to man from ingestion of edible tissue are included. 61 references, 9 figures, 4 tables.

29272 **(NUREG—0837-Vol.3-No.4) NRC TLD direct radiation monitoring network. Progress report, September-December 1983.** Costello, F.; Thompson, T.; Cohen, L.; Taylor, M. (Nuclear Regulatory Commission, King of Prussia, PA (USA). Region I). May 1984. 244p. NTIS, PC A11/MF A01 - GPO*. Order Number DE84901197.

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This report presents the results of the NRC Direct Radiation Monitoring Network for the fourth quarter of 1983. It provides the ambient radiation levels measured in the vicinity of 72 sites throughout the United States. In addition, it describes the equipment used, monitoring station selection criteria, characterization of the dosimeter response, data processing methods, calibration procedures, statistical methods, and quality assurance program. 8 figures, 7 tables.

29273 (ORNL—6009, pp 17-37) **Earth sciences.** Apr 1984. NTIS, PC A09/MF A01. Order Number DE84010672. TI84010672

In Environmental Sciences Division annual progress report for period ending September 30, 1983.

Research projects include radionuclide distributions in coastal areas, a germanium detector for quantitative measurement of radionuclides in soils, photon analysis of environmental samples, dry deposition of particles to inert and vegetation surfaces, a laboratory extraction method to simulate codisposal, leaching of solid wastes from the H-coal liquefaction process, weathering of pyrite and pyrrhotite, subsurface transport, geochemical calculations related to high-level waste repositories, geological characterization of Melton Valley, and the Waste Isolation Program. (ACR)

29274 **(PNL—5000-Pt.2) Pacific Northwest Laboratory annual report for 1983 to the DOE Office of Energy Research. Part 2. Ecological sciences.** Vaughan, B.E. (Pacific Northwest Lab., Richland, WA (USA)). Feb 1984. Contract AC06-76RL01830. 58p. NTIS, PC A04/MF A01; GPO Dep. Order Number DE84007998.

The 1983 annual report highlights research in five areas funded by the Ecological Sciences Division of the Office of Energy Research. The five areas include: western semi-arid ecosystems; marine sciences; mobilization fate and effects of chemical wastes; radionuclide fate and effects; and statistical and quantitative research. The work was accomplished under 19 individual projects. Individual projects are indexed separately.

29275 (PNL—5000-Pt.2, pp 25-29) **Radionuclide fate and effects.** Feb 1984. NTIS, PC A04/MF A01. Order Number DE84007998. TI84007998

In Pacific Northwest Laboratory annual report for 1983 to the DOE Office of Energy Research. Part 2. Ecological sciences.

The objective of these studies is to develop a basic understanding of radionuclide chemical behavior in soil systems and determine biological availability and transport through ecological pathways defining basic mechanisms at the chemical, cellular, and organism level, enables the incorporation of information into predictive models, which are subsequently validated in the field at reactor and waste management sites. Through investigations of critical geochemical, microbial, and plant phenomena, the precision with which human dose assessments are made is improved. The biologically and chemically mediated transport processes and food-chain pathways are studied rather than the purely physical forms of contaminant transport, such as transport by wind and water. Results can also be used to predict the behavior of non-nuclear pollutants such as heavy metals, and to provide a basis for new designs and remedial measures (chemical treatments, biobarriers) that will minimize hazards associated with extended waste disposal and isolation.

29276 (PNL—5000-Pt.2, pp 30-33) **Statistical and quantitative research.** Feb 1984. NTIS, PC A04/MF A01. Order Number DE84007998. TI84007998

In Pacific Northwest Laboratory annual report for 1983 to the DOE Office of Energy Research. Part 2. Ecological sciences.

Environmental impacts may escape detection if the statistical tests used to analyze data from field studies are inadequate or the

field design is not appropriate. To alleviate this problem, PNL scientists are doing theoretical research which will provide the basis for new sampling schemes or better methods to analyze and present data. Such efforts have resulted in recommendations about the optimal size of study plots, sampling intensity, field replication, and program duration. Costs associated with any of these factors can be substantial if, for example, attention is not paid to the adequacy of a sampling scheme. In the study of dynamics of large-mammal populations, the findings are sometimes surprising. For example, the survival of a grizzly bear population may hinge on the loss of one or two adult females per year.

29277 **(TVA/PUB—84/31) Environmental radioactivity levels, Browns Ferry Nuclear Plant. Annual report, 1983.** (Tennessee Valley Authority, Muscle Shoals, AL (USA). Radiological Health Staff). Apr 1984. 58p. NTIS, PC A04/MF A01. Order Number DE84901136.

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This report describes the environmental radiological monitoring of the Browns Ferry Nuclear Plant (BFN), located in Limestone County, Alabama, conducted in 1983. Dose estimates were calculated from concentrations of radioactivity found in samples of air, milk, meat, vegetation, drinking water, and fish. Estimated doses were essentially identical to those determined at control locations. 12 figures, 29 tables.

29278 **(TVA/PUB—84/32) Environmental radioactivity levels, Sequoyah Nuclear Plant. Annual report, 1983.** (Tennessee Valley Authority, Muscle Shoals, AL (USA). Radiological Health Staff). Apr 1984. 63p. NTIS, PC A04/MF A01. Order Number DE84901133.

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This report describes the environmental radiological monitoring of the Sequoyah Nuclear Plant (SQN) located in Hamilton County, Tennessee, conducted in 1983. Dose estimates were calculated from concentrations of radioactivity found in samples of air, milk, water, and fish. It was concluded there were no significant increases in the exposure to members of the general public attributable to the operation of SQN. 11 figures, 34 tables. (ACR)

29279 **Method for determining ^{231}Pa in biological samples.** Gies, R.A.; Ballou, J.E.; Case, A.C.; Ryan, J.L. (Pacific Northwest Lab., Richland, WA). *Health Physics;* **46**: No. 4, 928-932(Apr 1984).

Biological studies with ^{231}Pa required an analytical procedure that was specific for ^{231}Pa in the presence of its radioactive decay products. The decay series includes nine α emitters, six β emitters and 10 γ emitters, which may or may not be in radioactive equilibrium in the biological system. Consequently, the magnitude of the interference from daughter-product radioactivity is difficult to quantitate unless special efforts are taken to isolate ^{231}Pa from the decay series. A search of the scientific literature revealed several methods for separating ^{231}Pa from predominantly mineral matrices. Relatively few reports described methods for measuring ^{231}Pa in biological material. The authors combined certain of these methods and known procedures for tissue ashing, anion-exchange separation, and mixed-liquid extraction/liquid scintillation counting to establish a method for determining ^{231}Pa in laboratory-animal tissues.

29280 **Reduction of radiostrontium mobility in acid soils by carbonate treatment.** Browman, M.G.; Spalding, B.P. (Oak Ridge National Lab., TN). *Journal of Environmental Quality;* **13**: No. 1, 166-172(Jan-Mar 1984). Contract W-7405-ENG-26.

Development of chemical treatments to immobilize ^{90}Sr in soil to prevent its leaching from radioactive waste disposed in shallow land burial sites is highly desirable. Six in situ carbonate-precipitating treatments, varying the amounts of carbonate, alkaline earth cation (Ca or Ba as chlorides), and order of addition were examined for their ability to immobilize radiostrontium in laboratory soil columns. The Na_2CO_3-followed by $CaCl_2$-treatment was most consistently successful at reducing the leachability of radiostrontium by 0.05M $CaCl_2$ from three low organic matter-acid soils, immobilizing as much as 53% of added radiostrontium. For the high organic matter-slightly acid soil, Na_2CO_3 alone, without supplemental Ca or Ba, resulted in the best immobilization (39%); dissolution of soil organic matter and the alkalinity-induced aggregate dispersion probably interfered with $CaCO_3$ and/or $BaCO_3$ precipitation. Success of the treatments is based primarily on their ability to generate, in situ, $Ca(Sr,Mg)CO_3$ or $Ba(Ca,Mg,Sr)CO_3$ precipitates that exchange radiostrontium very slowly with eluting Ca ions. Allied tests with ^{137}Cs, which is commonly codisposed with ^{90}Sr, indicated that the treatments describe did not interfere with the natural tendency of the selected soils to fix ^{137}Cs strongly.

5105 Site Resource And Use Studies

REFER ALSO TO CITATION(S) 27799, 27804, 27805, 27807

29281 **(AD-A—136806/7) Installation restoration program. Phase I. Records search, Selfridge Air National Guard Base, Mount Clemens, Michigan.** (Environmental Control Technology Corp., Ann Arbor, MI (USA)). Apr 1983. 145p. NTIS, PC A07/MF A01.

During the course of this project, interviews were conducted with those past and present base personnel familiar with past waste disposal practices. File searches were performed for facilities which have generated, handled, transported, and disposed of waste materials. Interviews were held with local, state, and federal agencies, and site inspections were conducted at facilities that have generated, treated, stored, and disposed of hazardous waste. Seven disposal sites located on Selfridge ANGB property were identified as containing hazardous waste resulting from past waste disposal activities or significant fuel spills. These sites have been assessed using a hazard assessment rating methodology (HARM), which takes into account factors such as site characteristics, waste characteristics, potential for contaminant migration, and waste management practices. The details of the rating procedure are presented in Appendix E and the results of the assessment are given in Table ES-1. The rating system is designed to indicate the relative need for follow-on action.

29282 **(AD-A—136832/3) Installation restoration program records search for 159 tactical fighter group, Vermont Air National Guard, Burlington international airport.** (CH2M Hill Southeast, Inc., Gainesville, FL (USA)). Sep 1983. 135p. NTIS, PC A07/MF A01.

The Burlington ANG Installation records search included a detailed review of pertinent installation records, contacts with 12 government organizations for documents relevant to the records search effort, and an onsite installation visit conducted by CH2M HILL during July 5 through 8, 1983. Activities conducted during the onsite installation visit included interviews with 19 past and present installation employees, ground tours of installation facilities, and a detailed search of installation records.

29283 **(PB—84-150911) Effects of hazardous wastes on housing and urban development and mitigation of impacts.** Boyer, K.R.; Conrad, E.T.; Kane, P.F.; McLaughlin, M.W.; Morgan, J.T. (SCS Engineers, Inc., Reston, VA (USA)). 10 Oct 1980. 73p. NTIS, PC A04/MF A01.

This report determines the nature and scope of the hazardous waste problem affecting HUD programs and community development and redevelopment activities. It defines the problem and develops categories of hazardous wastes most applicable to HUD. The report identifies sources of hazardous waste and gives examples of their impacts. The role of HUD and other agencies in controlling hazardous waste is reviewed, and recommendations are made for mitigating known and potential impacts. Three case studies – in Dover Township and Elizabeth, N.J., and in Richmond, Va., illustrate the wide range of impacts made possible because of improper handling of or lack of appreciation for hazardous substances. The report suggests that a Hazard Identification Guidebook be developed, similar to others addressing housing safety and noise assessment, that would require HUD personnel to carry out a number of investigations on and around a site. This process is briefly described here and could serve as a basis for a guidebook. Flow charts illustrate this process. Tables and 23 references are supplied.

5106 Regulations

REFER ALSO TO CITATION(S) 28500

52 ENVIRONMENTAL SCIENCES, AQUATIC

REFER ALSO TO CITATION(S) 30094

29284 **(PB—84-148188) Freshwater findings, 1979-1982: research publications of the Environmental Research Laboratory, Duluth, Minnesota.** Highland, T.; Curtis, C. (Environmental Protection Agency, Duluth, MN (USA). Environmental Research Lab.). Oct 1983. 196p. (EPA—600/X-84-003). NTIS, PC A09/MF A01.

See also PB80-167257.

This report contains citations of publications for the years 1979-1982 on research conducted or supported by the Environmental Research Laboratory-Duluth. All published material has been organized into two major categories: (1) Journal Articles, Book Chapters, Proceedings, etc., and (2) EPA Research Reports. The report is organized by year with all journal articles, book chapters, proceedings, etc., for a given year appearing before the EPA research reports for the same year; within each category publications are listed alphabetically by author. Authors of the publications listed include ERL-Duluth laboratory staff members and scientists at universities, in industry, and at other facilities who received research funding under the auspices of the Environmental Research Laboratory-Duluth. Limited quantities of reprints are available for those articles identified by ERL-Duluth reprint number in parentheses following the citation. These can be obtained by writing to: Librarian, ERL-Duluth, U.S. EPA, 6201 Congdon Boulevard, Duluth, MN 55804. EPA research reports can be obtained by writing to: National Technical Information Service, 5285 Port Royal Road, Springfield, VA 22151. All other articles are not available from ERL-Duluth or NTIS, but can be found in most major libraries.

5201 Basic Studies

REFER ALSO TO CITATION(S) 29256, 29274, 29413

29285 (ANL—83-100-Pt.2, pp 33-34) **^{226}Ra and ^{228}Ra in Illinois municipal well waters.** Holtzman, R.B.; Gilkeson, R.H.; Hwang, E.Y.; Markun, F.; Seils, C.A. Mar 1984. NTIS, PC A09/MF A01. Order Number DE84008870. TI84008870

In Environmental Research Division annual report: Center for Human Radiobiology, July 1982-June 1983.

The concentrations of ^{226}Ra in well waters were determined for 255 well-water samples from 55 municipalities and industrial plants in Illinois. The ^{226}Ra concentrations in the potable waters tested ranged from 0.07 to 30 pCi/L. One one-potable brine from the Mount Simon aquifer had a concentration of 41 pCi/L. The mean concentration of ^{226}Ra in all the samples was 7.5 pCi/L. 1 figure, 1 table.

29286 (ANL—83-100-Pt.2, pp 46-50) **Gastrointestinal absorption of uranium in man.** Larsen, R.P.; Orlandini, K.A. Mar 1984. NTIS, PC A09/MF A01. Order Number DE84008870. TI84008870

In Environmental Research Division annual report: Center for Human Radiobiology, July 1982-June 1983.

A method has been established for determining the fractional absorption of uranium directly in man. Measurements are made of the urinary excretion rates of uranium for individuals whose drinking water has a high ^{234}U to ^{238}U activity ratio and is the primary source of ^{234}U in their diets. For two individuals, the values obtained for the fractional absorption of ^{234}U were 0.004 and 0.006. The values obtained for the fractional absorption of ^{238}U, using a literature value for the ^{238}U intake from food, were 0.008 and 0.015. The present ICRP value is 0.20. 7 references, 1 table.

29287 **(INIS-BR—98) Determination of the self purification of streams using tracers.** Salviano, J.S. (Minas Gerais Univ., Belo Horizonte (Brazil). Dept. de Engenharia Nuclear). Apr 1982. 123p. (In Portuguese). NTIS (US Sales Only), PC A06/MF A01. Order Number DE84780186.

A methodology for the 'in situ' evaluation of the self purification of streams is discussed. It consists of the simultaneous injection of two tracers into the stream. One of the tracers is oxidized by biochemical processes. It can be either artificially supplied to the stream or a naturally present component can be used. This tracer is used for the determination of the self purification parameters. The other tracer is conservative and allows for the hydrodynamic effects. Tests have been carried out in two streams with quite different hydrodynamic and physicochemical conditions. In the first stream, with a flow-rate of about 0.9 m^3/s, urea was used as the nonconservative tracer. In the other stream, which had a flow-rate of about 5 m^3/s, only a radioactive tracer has been used, and the rate of biochemical oxidation has been determined from BOD measurements. Calculations have been implemented on a digital computer. In both cases it was found that the reoxygenation rate is more conveniently determined by empirical formulas. Results from both tests have been deemed realistic by comparison with similar experiments. (Author).

29288 **(NP—4901103) Historical sequences of analyzed sea-surface temperature fields for application to studies of climate trends and regimes. Final report.** Holl, M.M.; Mendenhall, B.R.; Cuming, M.J. (Meteorology International, Inc., Monterey, CA (USA)). Jan 1981. 86p. Meteorology International Inc., PO Box 22920, Carmel, CA 93922. Order Number DE84901103.

An analysis system, based on the Fields by Information Blending (FEB) methodology, has been developed for analyzing sea-surface temperature (SST) distributions on specifiable ranges-of-scale for studies of climate trends and regimes. A world-wide SST data base has been compiled containing over 26 million reports (no duplicates) for 1946 to 1978. The analysis system can provide an estimate of the analysis reliability and the quality of individual SST observations in the context of the chosen analysis resolution. The system and data base have been used to generate a 33-year sequence (1946 to 1978) of 5-day-mean analyzed SST fields on a 63x120 Mercator grid encircling the earth between the Arctic and Anarctic Circles. Examples of the analyzed fields are included. The analysis sequence and data base are held on tape. 7 references, 19 figures.

29289 **(NUREG/CR—2803) Improved field experimental designs and quantitative evaluation of aquatic ecosystems.** McKenzie, D.H.; Thomas, J.M. (Pacific Northwest Lab., Richland, WA (USA)). May 1984. Contract AC06-76RL01830. 30p. (PNL—4138). NTIS, PC A03/MF A01 - GPO $3.75; GPO Dep. Order Number DE84012491.

The paired-station concept and a log transformed analysis of variance were used as methods to evaluate zooplankton density data collected during five years at an electrical generation station on Lake Michigan. To discuss the example and the field design necessary for a valid statistical analysis, considerable background is provided on the questions of selecting (1) sampling station pairs, (2) experimentwise error rates for multi-species analyses, (3) levels of Type I and II error rates, (4) procedures for conducting the field monitoring program, and (5) a discussion of the consequences of violating statistical assumptions. Details for estimating sample sizes necessary to detect changes of a specified magnitude are included. Both statistical and biological problems with monitoring programs (as now conducted) are addressed; serial correlation of successive observations in the time series obtained was identified as one principal statistical difficulty. The procedure reduces this problem to a level where statistical methods can be used confidently. 27 references, 4 figures, 2 tables.

29290 (PNL—5000-Pt.2, pp 12-16) **Marine sciences.** Feb 1984. NTIS, PC A04/MF A01. Order Number DE84007998. TI84007998

In Pacific Northwest Laboratory annual report for 1983 to the DOE Office of Energy Research. Part 2. Ecological sciences.

Coastal marine ecosystems will receive increasing amounts of contaminants as energy facilities are developed and expanded. The levels at which contaminants will disrupt or degrade coastal ecosystems through studies of the entrance, transformation, and fate of numerous chemical compounds are being determined. The work was approached through a combination of field measurement and laboratory experiments, with particular emphasis on the biologically active chemical forms of specific elements and compounds. At the organism level, the physiological processes associated with sequestering and detoxifying metals was examined. Results of this program may be used to predict, and subsequently minimize, long-range environmental consequences of current and future energy production processes located in coastal regions. 3 figures.

29291 **(TVA/PUB—84/27) Modeling taste and odor phytoplankton in Normandy Reservoir.** Beard, L.M.; Brown, R.T. (Tennessee Valley Authority, Norris (USA). Div. of Air and Water Resources). Mar 1984. 56p. NTIS, PC A04/MF A01. Order Number DE84901143.

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The feasibility of modeling particular algae associated with taste and odors was investigated as part of an effort to develop a two-dimensional water quality model applicable to Normandy and Columbia Reservoirs (Duck River, Tennessee). There does not appear to be any dominant factor controlling the occurrence and abundance of taste and odor causing algae. A summary of dominant algal patterns observed in Normandy Reservoir is provided. A simplified algal model using a fully mixed surface volume (bag) was developed to explore the possibility of modeling several algae types simultaneously. The results of a field algal assay involving nutrient additions to bags of indigenous algae suspended in the Duck River at Columbia, Tennessee, were summarized and simulated using the algae model. Some of the observed algal responses were reproduced with the model, while others remain unexplained. The specification of growth characteristics for individual algal types is the limiting factor in this approach because these have not been well documented. Growth characteristics for dominant algal species must be determined for more accurate modeling of taste and odor potential in Normandy and Columbia Reservoirs. 21 references, 25 figures, 1 table.

29292 **Variable ingestion rate and its role in optimal foraging behavior of marine deposit feeders.** Taghon, G.L.; Jumars, P.A. (Univ. of Washington, Seattle). *Ecology;* **65**: No. 2, 549-558(Apr 1984). Contract AT06-76EV75026.

Tests of optimal foraging theory have focused generally on food item selection by mobile, high-trophic-level predators. Deposit-feeding invertebrates are aquatic organisms with limited mobility and hence limited ability to forage actively for food-rich patches. In addition, there is little evidence for a major role of behaviorally mediated food item choice in these animals, and growing evidence of mechanical limitations in food particle choice. Given such limited food-selection ability, varying ingestion rate in response to changes in food value is likely to be an important animal response affecting feeding energetics. A previously developed optimal foraging model predicted that ingestion rate and food value should covary positively in order to maximize net time rate of energy gain. To test this general prediction, the authors fed three species of deposit-feeding polychaetes artifical sediments which varied only in protein content (food value); other physical and chemical properties which might affect ingestion rate were kept constant. In support of the model, ingestion rates increased as protein levels increased.

29293 **Combined autoradiography and immunofluorescence for estimation of single cell activity by ammonium-oxidizing bacteria.** Ward, B.B. (Univ. of Washington, Seattle). *Limnology and Oceanography;* **29**: No. 2, 402-410(Mar 1984). Contract AT06-76EV75026.

Immunofluorescence and $^{14}CO_2$ autoradiography were used for simultaneously enumerating and assaying the autotrophic activity of ammonium-oxidizing bacteria in seawater. Relative activity ($^{14}CO_2$ assimilation as measured by autoradiography) and abundance were measured in simulated in situ incubations at seven stations in the primary NO_2^- maximum region of the Northeast Pacific Ocean. More than 10^4 cells-liter^{-1} were present; relative activity often showed a peak near the surface and an increase in the NO_2^- max region below the photic zone. The method permits assessment of individual cell activity; most cells at all depths were active in CO_2 assimilation, usually at low and quite variable levels. Relative activity was positively correlated with the abundance of ammonium-oxidizing bacteria, temperature, total dark CO_2 assimilation and phenopigment concentration.

5202 Chemicals Monitoring And Transport

REFER ALSO TO CITATION(S) 27806, 27866, 27867, 27868, 27869, 27870, 27871, 27892, 27893, 28876, 29204, 29212, 29259, 29264, 29267, 29312, 29468, 29500

29294 **(ANL/ER—84-2) Ten-year forecasts of water quality in Lake Michigan using a deterministic eutrophication model.** Lesht, B.M. (Argonne National Lab., IL (USA)). Mar 1984. Contract W-31-109-ENG-38. 43p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE84011425.

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A dynamic, deterministic lake eutrophication model was used to forecast changes in Lake Michigan water quality over a ten-year simulation period. Emphasis was placed on changes in epiliminon phytoplankton biomass and in whole-lake total phosphorus concentration in response to changes in input phosphorus loads and to variations in winter conditions. Constant-condition simulations corresponding to current, increased, and reduced loads and to mild, average, and severe winters were used to establish bounds for the projected changes in water quality. Monte Carlo-type simulations were used to estimate the variance associated with the projections. Given the assumptions and limitations inherent in the modeling process, water quality in Lake Michigan is projected to improve slightly (reduced concentrations of phytoplankton and total phosphorus) over the next ten years. Year-to-year variations are significant, however, and will depend on loading and winter conditions. The variation in the projected values associated with the assumed fluctuations in loads and winter conditions is approximately 20 percent. 25 references, 20 figures, 4 tables.

29295 **(EPA—570/9-84-002) Surface impoundment assessment national report.** (Environmental Protection Agency, Washington, DC (USA). Office of Drinking Water). Dec 1983. 220p. NTIS, PC A10/MF A01. Order Number DE84901182.

The report presents a broad look at the use of impoundments for the disposal of waste liquids and sludges and the effects of that use on ground water quality. Individual state programs to manage impoundments are described. A manual for evaluating the contamination potential of surface impoundments is included. 40 figures, 27 tables. (ACR)

29296 **(FWS/OBS—80/40.14) Liming of acidified waters: issues and research - a report of the international liming workshop.** (Fish and Wildlife Service, Kearneysville, WV (USA). Eastern Energy and Land Use Team). Dec 1982. 43p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE84011779.

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This paper outlines the plan formulated by the participants. Three working groups identified critical issues associated with: (1) biological responses; (2) chemical changes; and (3) materials and application techniques related to the chemical neutralization of acidified surface waters. Important biological issues included: the impact of episodic acidification events, the impact of metal toxicity, the time and placement of base addition, energy flow and nutrient cycling alterations, short- and long-term ecological effects, and restocking strategies. Water chemistry issues included: sinks and sources of hydroxyl ions in aquatic ecosystems, responses of water chemistry to base addition, temporal and spatial relationships in water quality, and supplementary chemical treatments. The key issues related to materials and application techniques included: long-term reactivity rates of liming materials, application techniques for flowing water, prevention of episodic pH depressions, toxic metal immobilization strategies, and application strategies for supplementary and/or alternative treatments. The research require-

ments associated with each issue were discussed and linkages among the issues were identified. 61 references, 6 figures, 4 tables.

29297 **(GKSS—83/E/64) Mathematical simualtion model for environmental transport processes in tidal rivers and estuaries.** Haeuser, J.; Eppel, D.; Lobmeyr, M.; Mueller, A. (GKSS-Forschungszentrum Geesthacht G.m.b.H., Geesthacht-Tesperhude (Germany, F.R.)). 1983. 8p. (CONF-8306193—1). NTIS (US Sales Only), PC A02. Order Number DE84751505.

From 4. IASTED international symposium on modelling and simulation; Lugano, Switzerland (21 Jun 1983).

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A mathematical model is presented for numerical simulation of transient, two-dimensional transport processes in tidal rivers, bays and estuaries with particular emphasis to suspended sediment and heavy-metal transport.

29298 **(KFK—2992) Sulfate removal by anion exchange against bicarbonate ions.** Hoell, W.; Kiehling, B. (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Inst. fuer Radiochemie). Jun 1980. 33p. (In German). NTIS (US Sales Only), PC A03/MF A01. Order Number DE84751597.

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The sulfate concentration of various raw waters can be reduced by an anion exchange against bicarbonate ions. The use of calcium carbonate and carbon dioxide as regeneration chemicals leads to some important advantages. This exchange and regeneration method has been tested in a municipal water works. In these experiments the sulfate concentration could be reduced from 200 mg/l to 50 mg/l, a fact which principally proved the practicability of the process.

29299 **(KFK—3599) Development and experimental verification of a complex chemical equilibrium model for waters using the river Rhine water as an example.** Hennes, E.C. (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Inst. fuer Radiochemie; Karlsruhe Univ. (T.H.) (Germany, F.R.). Fakultaet fuer Chemie). Sep 1983. 176p. (In German). NTIS (US Sales Only), PC A09/MF A01. Order Number DE84751224.

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A model of the Rhine water based on complex chemistry is introduced which allows calculation of the form of chemical compounds taken by the water contents. By this model the inorganic main and trace components in the dissolved phase, hardly soluble compounds, as well as the contact with the atmosphere are taken into account. The system is solved mathematically by using the MULTI4 computer code. The Rhine water model and MULTI4 have been designed such that modifications in the composition can be conveniently performed. The experimental verification of the calculated composition of Rhine water was varried out by measurements of the conductivity of a model water. Calculation of the specifications of the main substances contained in Rhine water has shown that sulfate exerts the strongest influence on the overall degree of complexing. Of the cations above all Ca and Mg occur as complexes, most of them as sulfate compounds. Besides, the specifications of the heavy metal in the Rhine water were calculated which, depending on the cations, are present mainly as $Me(CO_3)^0$ compounds or as free cations. Fe occurs by more than 99% as colloidal FeOH. Moreover, the influence of nitrilotriacetic acid, a possible substitute for phosphate in detergents, on the heavy metal specifications in Rhine water was determined. Within the range of concentrations from 100-500 μg/l NTA the heavy metals considered, except for Fe, predominantly occur as $Me(NTA)^-$ complexes.

29300 **(ORNL—6009) Environmental Sciences Division annual progress report for period ending September 30, 1983.** (Oak Ridge National Lab., TN (USA)). Apr 1984. Contract AC05-84OR21400. 198p. NTIS, PC A09/MF A01; GPO Dep. Order Number DE84010672.

Environmental Sciences Division Publication No. 2261.

This annual report summarizes activities in the Aquatic Ecology, Earth Sciences, Environmental Analyses, and Terrestrial Ecology sections, as well as in the Fossil Energy, Biomass, Low-Level Waste Research and Management, and Global Carbon Cycle Programs. Separate abstracts have been prepared for each section. (ACR)

29301 (ORNL—6009, pp 1-16) **Aquatic ecology.** Apr 1984. NTIS, PC A09/MF A01. Order Number DE84010672. TI84010672

In Environmental Sciences Division annual progress report for period ending September 30, 1983.

Research in the areas of biogeochemical cycling of nutrients and contaminants, physiological ecology, ecotoxicology, and ecosystem dynamics is summarized. The summary discusses efforts with material spiralling in stream ecosystems, the role of environmental variables on the bioavailability and fate of polycyclic aromatic hydrocarbons in fish, the use of physiological processes in fish as indicators of ecosystem stress, research related to the occurrence of Legionnaires' Disease bacteria, and the evaluation of multispecies algal bioassays. (ACR)

29302 **(TVA/PUB—84/29) Effects of a runoff event on Normandy Reservoir water quality.** Brown, R.T. (Tennessee Valley Authority, Norris (USA). Div. of Air and Water Resources). Mar 1984. 63p. NTIS, PC A04/MF A01. Order Number DE84901145.

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Water quality of a reservoir at stratification is governed by runoff from spring storms. Regularly scheduled surveys are unlikely to capture these transient inflows. An intensive sampling effort during a storm event in Normandy Reservoir ($135 \times 10^6 m^3$ volume, 10 m mean depth) was made during April 1983. The purpose was to obtain estimates of suspended solids and nutrient loadings during the storm and to document subsequent water quality dynamics in Normandy Reservoir. Influence of suspended solids on light attenuation and phosphorous adsorption was analyzed. Suspended solids linearly increased the light attenuation coefficient. Turbidity was also linearly proportional to the extinction coefficient. Settling followed Stokes law estimates, with particles less than 4μm remaining in suspension much longer than larger sizes. Detritus loading was significant and contributed to sediment oxygen demand. A depression in alkalinity (35 mg/L to 10 mg/L) and pH (7.5 to 6.5) was observed during the peak inflow. Nitrogen loads were predominantly organic and very little increase in nitrate occurred in the reservoir. High concentrations of total phosphorous apparently settled with suspended solids. Dissolved phosphorus concentrations were increased somewhat, but not all the inflowing dissolved phosphorus remained in the reservoir. Implications for reservoir water quality surveys, nutrient loading estimates, and reservoir water quality models are discussed. 7 references, 29 figures, 1 table.

5203 Radioactive Materials Monitoring And Transport

REFER ALSO TO CITATION(S) 27952, 27972, 27974, 27977, 29235, 29236, 29237, 29238, 29239, 29240, 29241, 29244, 29245, 29246, 29247, 29248, 29277, 29278, 29285, 29286

29303 **(PNL-SA—12093) Comparison of analytical charge-form and equilibrium thermodynamic speciation of certain radionuclides.** Jenne, E.A.; Cowan, C.E.; Robertson, D.E. (Pacific Northwest Lab., Richland, WA (USA)). Feb 1984. Contract AC06-76RL01830. 11p. (CONF-840408—13). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE84011896.

From 5. international conference on nuclear methods in environmental and energy research; Mayaguez, Puerto Rico (2 Apr 1984).

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Calculating trace element speciation with a thermodynamic model is often challenged on the basis that the existing thermodynamic data are not sufficiently reliable. Water quality data and corresponding analytical charge-form speciation analyses were available for radionuclides occurring in a low-level radioactive groundwater. This offered a unique opportunity for comparing the results of an equilibrium thermodynamic model with the results of analytical charge-form speciation. The charge-form speciation was determined using the Battelle Large Volume Water Sampler, which con-

tains consecutive layers of cation resin, anion resin and activated aluminum oxide for retention of cationic, anionic and non-ionic dissolved chemical species, respectively. The thermodynamic speciation of Cs, Cr, Fe, I, Mn, Mo, Na, and Zn was calculated using the MINTEQ geochemical model. Other radioactive elements (Ce, Co, Tc, Np, Pm and Sb) were speciated by hand calculation. Excellent agreement between the analytically determined charge-form and the thermodynamic speciation was observed for several radionuclides (^{54}Mn, ^{144}Ce, ^{131}I, ^{24}Na, ^{137}Cs, ^{99}Mo, ^{99}Tc, ^{151}Pm, ^{131}Np). Organic complexation by natural and/or synthetic organics in the waters may be important in the speciation of ^{65}Zn, ^{60}Co, ^{131}I, ^{59}Fe and possibly ^{51}Cr. Both ^{124}Sb and ^{125}Sb appeared to be in redox disequilibria with the groundwater. 28 references, 2 tables.

5204 Thermal Effluents Monitoring And Transport

REFER ALSO TO CITATION(S) 27892

29304 **(DP-MS—83-127) Benthic macroinvertebrate community structural and functional group response to cooling water discharge in the Savannah River and a coastal plain tributary.** Poff, N.L.; Matthews, R.A. (Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Lab.; Savannah River Ecology Lab., Aiken, SC (USA)). 1984. Contract AC09-76SR00001. 34p. (CONF-840565—2). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE84011517.

From 32. annual North American Bethological Society meeting; Raleigh, NC, USA (23 May 1984).

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Benthic macroinvertebrate community structure and functional groups on leaf detritus in a thermal, post-thermal and an undisturbed stream, and in the Savannah River immediately downstream from each stream mouth, were compared over a 7 wk (48d) period from December 1982 to February 1983. Ambient temperatures n the post-thermal and undisturbed streams ranged from 4 to 8 and 4 to 11°C, respectively, and from 7 to 12°C in the Savannah River. Temperatures in the thermal stream fluctuated irregularly between 7 to 31°C and in the river below this stream mouth between 7 to 22°C. A total of 13,993 macroinvertebrates representing at least 51 families and 84 genera was collected. Numbers of organisms and taxa were depressed at the thermal stream site, whereas numbers of both organisms and taxa increased at the river site receiving thermal influence. Chironomids of the subfamily Orthocladiinae comprised 46 to 60% of the fauna at all sites except in the thermal stream, where they comprised 5%. Physa (Gastropoda), Ablabesmyia (Tanypodinae) and Tanytarsus (Chironominae) each contributed over 20% of the fauna at the thermal stream. Cheumatopsyche (Trichoptera) represented 12 to 13% of the riverine fauna at the ambient sites, but 25% at the thermally-perturbed site. Collectors (mostly gatherers) contributed 51 to 75% at all sites except the thermal stream where scrapers dominated with 39%. Filterer relative abundance increased from 16 to 19% at the ambient river sites to 29% at the thermally-perturbed river site, suggesting that suspended carbon transport from the thermal stream occurred and subsidized the macroinvertebrate community in the Savannah River. 48 references, 3 figures, 2 tables.

5205 Site Resource And Use Studies

REFER ALSO TO CITATION(S) 27959

29305 **(AD-A—137106/1) Commencement bay studies phase ii, environmental impacts assessment. Final report Jan 82-Aug 83.** Isakson, J.S.; Houghton, J.P.; Johnston, S.A. (Dames and Moore, Seattle, WA (USA)). Oct 1983. 187p. NTIS, PC A09/MF A01.

Dames and Moore assessed the environmental impacts associated with development of 37 projects planned or conceived for Commencement Bay study area. Elements of the natural and human environments assessed for each project included fish, invertebrates, birds, water quality, sediment quality, wetlands, land and water use, noise, and recreational, historic, archaeological, and aesthetic resources. Baseline data against which project impacts were assessed were developed from the COBS I effort and other studies performed in the study area.

29306 **(DP-MS—83-120) Description of the larval pirate perch, Aphredoderus sayanus (Gilliams), from the Savannah River.** Minton, A.L.; Osteen, D.V.; Snyder, D.E. (Environmental and Chemical Sciences, Inc., Aiken, SC (USA); Colorado State Univ., Fort Collins (USA). Larval Fish Lab.). 15 Mar 1984. Contract AC09-76SR00001. 5p. (CONF-8405146—1). NTIS, PC A02/MF A01; GPO Dep. Order Number DE84011140.

From 8. annual larval fish conference; Vancouver, Canada (6 May 1984).

Larval pirate perch in a size range from 5.7 to 13.6 mm are described from 32 specimens. These fish were collected from the Savannah River during March, April, and May 1983. The description, drawings, and measurements extend the present knowledge of this species to include smaller specimens than previously recorded. 2 tables.

29307 **(DPST—84-252-Vol.1) Annual report on the Savannah River Aquatic Ecology program, September 1982-August 1983. Volume I.** Paller, M.; O'Hara, J.; Osteen, V.; Specht, W.; Kania, H. (Environmental and Chemical Sciences, Inc., Aiken, SC (USA)). Jan 1984. Contract AC09-76SR00001. 275p. (ECS-SR—8-Vol.1). NTIS, PC A12/MF A01; GPO Dep. Order Number DE84012068.

This document reports on the Savannah River Aquatic Ecology Program for the period September 1982 through August 1983. Volume 1 covers fisheries studies including ichthyoplankton, entrainment, impingement, diurnal studies, adult fish studies and special quality assurance tests and quality assurance programs. 22 figures, 61 tables.

29308 **(PB—84-143692) Microsystem sediment-water simulation: a practical technique for predicting reservoir water quality.** Craft, D. (Bureau of Reclamation, Denver, CO (USA). Engineering and Research Center). Oct 1983. 15p. (REC-ERC—83-12). NTIS, PC A02/MF A01.

Water quality at the bottom of a lake or reservoir may be conveniently simulated in a controlled laboratory environment using the technique of microsystem sediment-water simulation. The technique provides predictive data on planned or existing reservoirs and lakes by duplicating conditions expected at the sediment-water interface including anaerobic (chemically reducing) conditions which may occur in the hypolimnion during summer and winter stratification. Using many small sediment-water 'microsystems' allows for replication and the estimation of experimental error, as well as application of a variety of analytical chemical techniques for characterizing the simulation water.

29309 **(PB—84-148733) Control of asbestos fiber loss from asbestos-cement watermain. Final report Oct 80-Jun 82.** (Weston Water Utility, Schofield, WI (USA)). Jan 1984. 60p. NTIS, PC A04/MF A01.

The Weston, Wisconsin Water Utility discovered the deterioration of a portion of its asbestos-cement watermain and subsequently research to identify an effective means of halting the release of asbestos fibers into its potable water was begun. Three techniques were investigated for eliminating or reducing the release of fibers into the water: (a) formation of a protective metallic precipitate layer on the pipe surface utilizing zinc chloride, (b) in situ cement-mortar lining of the pipe, and (c) flushing of watermains. Implementation of the above three asbestos control processes would have widely differing capital and operational costs.

29310 **(PB—84-149087) Summary and analysis of state and selected foreign procedures for determining the costs of natural resource damages from releases of oil or hazardous materials.** Stein, R.J.; Gundlach, E.R.; Covell, S.; Golob, R.; Hopkins, P.R. (Research Planning Inst., Inc., Columbia, SC (USA)). 1983. 244p. NTIS, PC A11/MF A01.

The report summarizes and analyzes the procedures currently used by all 50 U.S. states, Puerto Rico, the Virgin Islands, and selected foreign countries and international organizations to estimate the costs associated with natural resource damages for spills of oil and hazardous substances. The report focuses on simplified damage assessments which, for the purposes of this study, were de-

fined as a set or sets of standardized procedures requiring minimal field observations and providing reasonable, cost-effective methodologies for establishing and quantifying in monetary terms damages to natural resources incurred as a result of a discharge of oil or a release of hazardous substances.

5206 Regulations

REFER ALSO TO CITATION(S) 29310

53 ENVIRONMENTAL-SOCIAL ASPECTS OF ENERGY TECHNOLOGIES

5301 Social And Economic Studies

REFER ALSO TO CITATION(S) 28294, 28500, 28501, 28510, 29314

29311 **(PB—84-163989) Att rapportera stralningsmaetdata (reporting of indication data).** Anjar, B.; Gunnerhed, M. (Foersvarets Forskningsanstalt, Sundbyberg (Sweden)). Dec 1983. 48p. (FOA-C—30352-E). NTIS, PC AE04/MF E01.

Text in Swedish.

In order to improve our nuclear power accident emergency planning, a more rapid and safer reporting of radiation measuring values from the surroundings of a nuclear power plant is needs. On the basis of these measured values, the County Administration has to make a decision concerning evacuation. In this pilot study the needs of information of different interested parties have been analysed, and certain bases for a monitoring organization have been stated. The needs are summarized in a specification on demands. Starting from this specification, a principal solution is presented with a number of automatic measuring stations placed in a circle around the nuclear power plant, as well as in certain centers of population. The organization is complemented with patrols. Possible technical solutions are described technically and economically. This pilot study provides a starting point for a decision concerning future purchasing of technical equipment.

5302 Assessment Of Energy Technologies

REFER ALSO TO CITATION(S) 28524

29312 **(DOE/BP—254) Environmental aspects of the aluminum industry in the Bonneville Power Administration service area and their relationship to audit based electrical energy conservation measures.** (Seton, Johnson, and Odell, Inc., Portland, OR (USA)). Apr 1984. Contract AC79-83BP11279. 75p. NTIS, PC A04; 3; GPO Dep. Order Number DE84012034.

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This report presents a brief historical sketch of the aluminum industry in the Bonneville Power Administration (BPA) service area, summarizes the primary aluminum production processes, and describes the environmental impacts resulting from the production of primary aluminum. It then assesses the applicability of audit-based electrical energy conservation measures to the primary aluminum industry and assesses the potential for environmental side effects of the application of those measures which are practicable in the industry. The magnitude of potential effects are assessed, and the potential for any regional combination of effects is also examined. The scope of this report is confined to the primary aluminum production processes and their associated ancillary activities. It is intended for the individual not thoroughly familiar with the aluminum production process, and investigation of the energy and environmental interactions in this report is limited to primarily audit-based electrical energy conservation measures, which include energy-efficient motors, variable speed drives, lighting, and certain operation and maintenance activities. The potential for environmental effects of certain process modifications is also briefly addressed. 14 references, 20 figures, 17 tables.

29313 (ORNL—6009, pp 38-51) **Environmental analyses.** Apr 1984. NTIS, PC A09/MF A01. Order Number DE84010672. TI84010672

In Environmental Sciences Division annual progress report for period ending September 30, 1983.

Research projects include extrapolating effects of whole effluents, soil-solution concentration calculation for risk analysis of synfuels, models for the behavior and fate of long-lived contaminants in fishes, environmental compliance activities, integrated assessment methods development for analysis of acid rain issues, data coordination and data base administration for acid deposition assessment, and environmental impact assessments of the decommissioning of a uranium mill and geothermal projects. (ACR)

29314 **Environmental and social costs of biomass energy.** Pimentel, D.; Fried, C.; Olson, L.; Schmidt, S.; Wagner-Johnson, K.; Westman, A.; Whelan, A.; Foglia, K.; Poole, P.; Klein, T. (Cornell Univ., Ithaca, NY). *BioScience;* **34**: No. 2, 89-94(Feb 1984). Contract AC02-81ER60002.

Biomass could provide as much as 11% of US energy needs by the year 2000; however, serious environmental and socioeconomic problems associated with biomass energy necessitate careful analysis of the benefits and risks. The environmental problems include: conflicts over land and water resources with agricultural and forestry production; increased soil erosion and nutrient loss; plus higher levels of air pollution. Socioeconomic problems include an increase in occupational injuries and illnesses and a rise in land and farm commodity prices. 53 references.

5303 Environmental Impact Statements

REFER ALSO TO CITATION(S) 28382

29315 **(DOE/EIS—0093-F) 1982 rate proposal. Final environmental impact statement.** (USDOE Bonneville Power Administration, Portland, OR). Aug 1982. 276p. NTIS, PC A13/MF A01; 1; GPO Dep. Order Number DE84011247.

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This statement evaluates the potential physical and socioeconomic environmental impacts associated with an increase in the wholesale power rates of the Bonneville Power Administration (BPA). Examined are the effects of an increase in power rates in 1982 and the cumulative effects of rate increases occurring or scheduled to occur during the period of 1979-1985. Included in this analysis are environmental impacts expected from implementation of five alternative revenue level scenarios: a no action alternative, the proposed BPA alternative, which would produce a 43 percent increase in revenue relative to revenue which would be generated under existing rates, a modification of the proposed alternative to reflect potential changes in BPA repayment policy, a long run incremental cost (LRIC) alternative, and a phased-in LRIC alternative. Effects on regional generation requirements, substitution of other fuels for electricity, effects on utility costs and on retail electricity rates, and impacts on consumers and regional irrigated agriculture are major areas of analysis. The potential impacts associated with a variety of rate designs and alternatives to BPA's proposed rate schedules for priority firm power, industrial firm power, new resources firm power, nonfirm energy, and wholesale firm capacity are also addressed. Discussions of measures to mitigate the environmental impacts of both revenue level alternatives and rate design alternatives are presented.

55 BIOMEDICAL SCIENCES, BASIC STUDIES

5501 Behavioral Biology

REFER ALSO TO CITATION(S) 29492

5502 Biochemistry

REFER ALSO TO CITATION(S) 28928, 28959, 29358, 29370, 29405, 29409, 29411, 29442, 29444, 29486, 29487, 29488

29316 **(AD-A—953042/9) Progress report on contracts n6-ori-99 and at(30-1)910.** Brown, G.B. (Sloan-Kettering Inst. for Cancer Research, New York (USA)). 6 Mar 1951. 22p. NTIS, PC A02/MF A01.

No abstract available.

29317 **(BNL—34681) Neutron scattering and the 30 S ribosomal subunit of E. coli.** Moore, P.B.; Engelman, D.M.; Langer, J.A.; Ramakrishnan, V.R.; Schindler, D.G.; Schoenborn, B.P.; Sillers, I.Y.; Yabuki, S. (Brookhaven National Lab., Upton, NY (USA); Yale Univ., New Haven, CT (USA)). 1982. Contract AC02-76CH00016. 18p. (CONF-8206240—7). NTIS, PC A02; 3; GPO Dep. Order Number DE84012174.

From Brookhaven symposium biology 32; Upton, NY, USA (1 Jun 1982).

Paper copy only, copy does not permit microfiche production.

This paper reviews the progress made in the study of the internal organization of the 30 S ribosomal subunit of E. coli by neutron scattering since 1975. A map of that particle showing the position of 14 of the subunit's 21 proteins is presented, and the methods currently used for collecting and analyzing such data are discussed. Also discussed is the possibility of extending the interpretation of neutron mapping data beyond the limits practical today. 30 references, 5 figures.

29318 **(DOE/CS/84005—T1) Isolation and characterization of the opsin gene from Halobacterium halobium.** (California Univ., San Diego, La Jolla (USA)). 1984. Contract FG02-80CS84005. 2p. NTIS, PC A02/MF A01; GPO Dep. Order Number DE84011782.

This report summarizes the isolation and characterization of the gene for bacteriorhodopsin from Halobacterium halobium.

29319 **(DOE/CS/84005—T2) Isolation and characterization of the opsin gene from Halobacterium halobium.** (California Univ., San Diego, La Jolla (USA)). 1984. Contract FG02-80CS84005. 2p. NTIS, PC A02/MF A01; GPO Dep. Order Number DE84011472.

The purpose of this project was to clone and characterize the gene which codes for bacteriorhodopsin in halobacteria. Three approaches were used in the attempt: Plus-minus hybridization using labelled RNAs from an overproducer and a nonproducer mutant, screening genomic libraries using synthetic oligomeric probes, and screening of plasmids from producer and nonproducer cells.

29320 **(DOE/ER/10678—4) Environmental stress mediated changes in transcriptional and translational regulation of protein synthesis in crop plants. Progress report.** Kochert, G.; Key, J.L. (Georgia Univ., Athens (USA). Research Foundation). May 1984. Contract AS09-80ER10678. 9p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE84012171.

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This report focuses on the development of thermotolerance in soybeans under varying heat shock (hs) regimes, and specifically addresses the isolation of genomic clones to hsp's 70 and 84 kd, the purification of hsp's for use in antibody preparation and chloroplast protein synthesis during hs. 4 references.

29321 **(DOE/ER/12003—5) Investigation of the nature of semisynthetic esterases. Progress report, September 15, 1981-April 15, 1984.** Keyes, M.H.; Vasan, S. (Owens-Illinois, Inc., Toledo, OH (USA)). Apr 1984. Contract AC02-81ER12003. 28p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE84012399.

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Two semisynthetic esterases have been identified by conformational modification of ribonuclease. The esterases have been designated as the acid-esterase and neutral-esterase, on the basis of their pH optimum. Kinetic studies have been performed on the esterases, after purification to 100 fold by means of ammonium sulfate fractionation and gel filtration. Acid-esterase hydrolyzes ethyl esters of many amino acids but showed a specificity towards substrates containing aromatic residues. Neutral-esterase was more specific towards ethyl esters of tryptophan and N-acetyltryptophan. Both esterases showed definite amidase activity. Acid-esterase was competitively inhibited by L-tryptophan, but neutral-esterase activity was not influenced by this amino acid.

29322 **(DOE/EV/01071—2) Genetics and biochemistry of DNA repair in Neurospora crassa. Final research report, September 1978-March 1984.** Mishra, N.C. (South Carolina Univ., Columbia (USA). Dept. of Biology). Mar 1984. Contract AS09-78EV01071. 30p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE84010816.

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This study evaluates the specific role of DNA polymerase and deoxyribonuclease in the process of DNA repair in eukrayotes by a comparison of the mutant and wild type enzymes. 6 figures, 3 tables.

29323 **(DOE/EV/02725—T2) Repair of DNA treated with γ-irradiation and chemical carcinogens. Progress report, 1980-1983.** Goldthwait, D.A. (Case Western Reserve Univ., Cleveland, OH (USA). Dept. of Biochemistry). 1 Feb 1984. Contract AC02-76EV02725. 28p. NTIS, PC A03/MF A01; GPO Dep. Order Number DE84011508.

We have studied in vitro DNA repair with the isolation and characterization of DNA glycosylases active in the removable of 3-methyladenine and the problem of repair of DNA in chromatin. The second area of focus has been on transposable elements and carcinogen action. The work on DNA adducts with β-propiolactone was done to define potential new substrates usefui in a search for new glycosylases.

29324 (INP—1080/PL, pp 195-203) **Study of thermal denaturation of β-galactosidase by nuclear magnetic relaxation.** Rydzy, M.; Skrzynski, W. (Uniwersytet Jagiellonski, Krakow (Poland)). 1980. (In Polish). NTIS (US Sales Only), PC A13/MF A01. Order Number DE84780233. (CONF-791295—). TI84780233

From 12. national seminar on nuclear magnetic resonance and its applications; Cracow, Poland (3 Dec 1979).

The results of thermal denaturation of β-galactosidase from bull liver studied by nuclear magnetic relaxation are presented. The measurements of relaxation time were performed at resonance frequency 26.0 MHz on spin echo spectrometer with 2% accuracy.

29325 (INP—1080/PL, pp 209-213) **Proton spin-lattice relaxation in lysozyme solutions.** Blicharska, N.; Rydzy, M. (Uniwersytet Jagiellonski, Krakow (Poland). Inst. Fizyki). 1980. (In Polish). NTIS (US Sales Only), PC A13/MF A01. Order Number DE84780233. (CONF-791295—). TI84780233

From 12. national seminar on nuclear magnetic resonance and its applications; Cracow, Poland (3 Dec 1979).

Proton spin-lattice relaxation in lysozyme solutions was studied. The measurements of spin-lattice relaxation times were performed on spin echo spectrometer at frequency 26.0 MHz by impulse sequence method.

29326 **(LBL—17654) Genetic-physical mapping of a photosynthetic gene cluster in Rhodopseudomonas capsulata.** Zsebo, K.M. (Lawrence Berkeley Lab., CA (USA)). Apr 1984. Contract AC03-76SF00098. 163p. NTIS, PC A08/MF A01; 1; GPO Dep. Order Number DE84012056.

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The photosynthesis genes of Rhodopseudomonas capsulata are investigated using transposon mutagenesis, phenotypic characterization of transposon induced mutants, and complementation analysis. The genes investigated are located on an R-prime plasmid, pRPS404, containing 50 kilobase pairs of R. capsulata DNA. A gene replacement scheme is described utilizing the antibiotic resistance markers from Tn7 and the instability of pRPS404 in a recombination proficient background. A transposon, Tn5.7, has been constructed incorporating the antibiotic resistance markers from Tn7 and the transposition functions from Tn5. It was used to mutagenize the plasmid pRPS404. In conjunction with the mutagenesis, physical mapping of the restriction endonuclease recognition sites for XhoI, Bg1II, KpnI, and SstI on pRPS404 has been accomplished. Sixty insertions of Tn5.7 into the R. capsulata DNA on the plasmid were isolated and thirty-one of these were crossed into the R. capsulata chromosome with subsequent deletion of wild type alleles. Mutants were characterized by absorption spectroscopy. SDS-PAGE, and determination of capability for photosynthetic growth. Many mutations in the bacteriochlorophyll and the carotenoid biosynthesis genes were isolated. A regulatory mutation was isolated affecting reaction centers as well as a 44kd heme containing polypeptide. Mature bacteriochlorophyll, carotenoids, and light harvesting complexes are made in this mutant. Complementation analysis using various pRPS404::Tn5.7 plasmids has led to the postulation of transcriptional units including bacteriochlorophyll and carotenoid biosynthetic genes as well as reaction center structural genes. 97 references, 34 figures, 10 tables.

29327 **(LBL—17712) Plasma membrane reorganization induced by chemical transformation in cultura.** Packard, B.S. (Lawrence Berkeley Lab., CA (USA)). Apr 1984. Contract AC03-76SF00098. 162p. NTIS, PC A08/MF A01; 1; GPO Dep. Order Number DE84012311.

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Induction of increased rigidity in the plasma membrane paralleling properties associated with a transformed state was suggested by two experiments. Fluorescence recovery after photobleaching (FRAP) indicated the induction of an environment in the plasma membrane where the synthetic fluorescent phospholipid collarein was immobile on the FRAP timescale. The other technique revealed the binding of epidermal growth factor (EGF) to a cryptic class of receptors which become accessible upon chemical transformation. These two lines of evidence are consistent with a reorganization of the plasma membrane induced by tumor promoters. 110 references, 38 figures, 4 tables.

29328 **(LMF—104) Review of the literature on enzymatic reduction of nitrocompounds.** Hadley, W.M. (Inhalation Toxicology Research Inst., Albuquerque, NM (USA)). Feb 1983. Contract AC04-76EV01013. 21p. NTIS, PC A02/MF A01; GPO Dep. Order Number DE84012995.

If more accurate assessment of the risk associated with human exposure to nitrocompounds (NCs) in combustion products, drugs, industrial chemicals and agricultural chemicals are to be made. An understanding of the enzymatic reduction of NCs must be acquired. This review covers the literature through November 1982 on reduction by enzymes of nitro groups attached to organic compounds. Much of the nitroreduction literature has focused on the metabolism of p-nitrobenzoic acid, 4-nitroquinoline 1-oxide, the nitrofurans, and the nitroimidazoles. A few papers report the reduction of other NCs such as the nitrophenols, nitrotoluenes and nitrobenzenes. Only very limited information is available on the reductive metabolism of multi-ring NCs.

29329 (ORNL—6021, pp 5-7) **Control of transcription in eukaryotic systems and studies of DNA-protein interaction.** Niyogi, S.K.; Hellwig, R.J.; Ayer, S.P.; Allison, D.P.; Yette, M.L. Jan 1984. NTIS, PC A12/MF A01. Order Number DE84006248. TI84006248

In Biology Division. Progress report, August 1, 1982-September 30, 1983.

The nuclear matrix is the residual nuclear structure obtained after removal of the nuclear membrane and bulk chromatin. During the last few years, a number of important functions have been shown to occur in the nuclear matrix, for example, DNA replication, transcription and processing of RNA and its transport, steroid hormone action, etc. Most of the evidence has come from in vivo studies. During the last year we have conducted studies to optimize the conditions for the isolation of HeLa nuclear matrix at low temperatures (0 to 4°C). We have found that pancreatic DNase I and Alu I, the restriction endonuclease, are effective in almost completely digesting the nuclear DNA within 60 min either at room temperature or 0°C.

29330 (ORNL—6021, pp 7-11) **Structural aspects of DNA in its replication and repair.** Mitra, S.; Pal, B.C.; Foote, R.S.; Bates, R.C.; Bhattacharyya, A.; Snow, E.T.; Wobbe, C.R.; Morse, C.C.; Snyder, C.E. Jan 1984. NTIS, PC A12/MF A01. Order Number DE84006248. TI84006248

In Biology Division. Progress report, August 1, 1982-September 30, 1983.

The research objective of this laboratory is to investigate the structure of DNA, the mechanism of DNA replication and its regulation, and the mechanism and role of repair of the altered DNA in the expression of heritable changes. This research has two broad aims, namely investigation of (a) the regulation of DNA replication in mammals, using parvovirus DNA as a model system and (b) the role of DNA repair in mutagenesis and carcinogenesis induced by simple alkylating mutagens.

29331 (ORNL—6021, pp 12-13) **Processing of RNA in yeast.** Stevens, A. Jan 1984. NTIS, PC A12/MF A01. Order Number DE84006248. TI84006248

In Biology Division. Progress report, August 1, 1982-September 30, 1983.

Studies on a yeast exoribonuclease and endoribonuclease are reported. It has been suggested that the exoribonuclease may have an important function in the cell in the degradation or turnover of mRNA after removal of the 5′ cap structure by a decapping enzyme which is found closely associated with the enzyme. The hydrolysis of yeast poly(A)-containing RNA by the endoribonuclease is inhibited by ethidium bromide and proflavin, which intercalate in double-stranded structures. At low enzyme concentrations, the hydrolysis is stimulated several-fold by small nuclear NRAs U1 and U2 of Novikoff hepatoma cells. The stimulation appears to involve an interaction of the small nuclear RNA with the poly(A)-containing RNA.

29332 (ORNL—6021, pp 13-15) **Modification of structures and functions of proteins involved in phage T5 DNA replication.** Fujimura, R.K.; Roop, B.C. Jan 1984. NTIS, PC A12/MF A01. Order Number DE84006248. TI84006248

In Biology Division. Progress report, August 1, 1982-September 30, 1983.

Work on the characterization of the T5 DNA polymerase has shown that T5 DNA polymerase is a monomeric, multifunctional enzyme. Its most preferred primer template is single-stranded DNA with a primer. It preferentially binds to such DNA at a 3′-OH primer end. However, it does bind to a nick of duplex DNA and utilizes a 3′-OH end of a nick as a primer and elongates it from such an end, displacing the strand ahead of it. Gene product D5 has a dual role in DNA replication and control of transcription. It is essential for shutoff of some early transcriptions and for the expression of late genes. There are about 500,000 copies per cell, making it the most abundant DNA-binding protein synthesized in T5 phage-infected cells. It binds to both double- and single-stranded DNA, but with higher affinity and cooperativity to double-stranded DNA.

29333 (ORNL—6021, pp 16) **Nucleic acid biochemistry of cells.** Volkin, E.; Boling, M.E.; Jones, M.H. Jan 1984. NTIS, PC A12/MF A01. Order Number DE84006248. TI84006248

In Biology Division. Progress report, August 1, 1982-September 30, 1983.

We have shown that nucleotide biosynthesis in Novikoff hepatoma and CHO cells is markedly altered by a variety of chemical

mutagens (N-methyl-N'-nitro-N-nitrosoguanidine, 4-nitroquinoline 2-oxide, 9-aminoacridine, and mitomycin C). These compounds cause inhibition of RNA and DNA synthesis bringing about a large increase in the pool levels of all four nucleoside triphosphates. The biosynthetic pathways leading to the synthesis of CTP from oxigenous uridine and GTP and ATP from exogenous hypoxanthine are severely inhibited. These observations suggest that, in addition to the reactions with DNA, nucleotide biosynthesis is another important biochemical target of chemical mutagens.

29334 (ORNL—6021, pp 17-18) **Chromosome chemistry.** Olins, D.E.; Olins, A.L.; Laughlin, T.J.; Allen, R.L.; Cadilla, C.L.; Roberson, A.E.; Herrmann, A.L.; Horton, C.Y.; Harp, J.M.; Finch, J.H. Jan 1984. NTIS, PC A12/MF A01. Order Number DE84006248. TI84006248

In Biology Division. Progress report, August 1, 1982-September 30, 1983.

The laboratory has concentrated its efforts on chromatin structure in the hypotrichous ciliated protozoa, and on 3-D reconstruction of a transcriptionally-active gene by electron microscope tomography.

29335 (ORNL—6021, pp 18-20) **Nucleosome and chromatin biophysics.** Bunick, G.J.; Uberbacher, E.C.; Hingerty, B.E. Jan 1984. NTIS, PC A12/MF A01. Order Number DE84006248. TI84006248

In Biology Division. Progress report, August 1, 1982-September 30, 1983.

Efforts have been concentrated in three major directions: (1) x-ray crystallography of avian erythrocyte mononucleosomes; (2) small-angle neutron scattering studies of nucleosomes, HMG-nucleosome complexes, and nucleosome oligomers; (3) molecular modeling and energy refinement of DNA-carcinogen adducts.

29336 (ORNL—6021, pp 22-25) **Structure and organization of the eukaryotic genome with special emphasis on satellite DNAs and the phenomenology and control of the crustacean molt cycle.** Skinner, D.M.; Bonnewell, V.; Fowler, R.F.; Haas, B.; Mykles, D.L.; Soumoff, C. Jan 1984. NTIS, PC A12/MF A01. Order Number DE84006248. TI84006248

In Biology Division. Progress report, August 1, 1982-September 30, 1983.

The Bermuda land crab, Gecarcinus lateralis has been cloned into three different restriction enzyme sites of satellite DNA. A series of variants of the satellite contain transitions, transversions, amplifications, insertions and/or deletions from specific regions of as little as a few and as many as some hundreds of base pairs. The cloned variants of the satellite offer a unique opportunity to determine structure-function interactions. Three of the cloned satellite variants have been sequenced.

29337 (ORNL—6021, pp 25-27) **Enzyme and gene regulation: normal mechanisms and responses to toxic metal ions.** Jacobson, K.B.; Wright, E.B.; Flanagan, J.; Ferre, J. Jan 1984. NTIS, PC A12/MF A01. Order Number DE84006248. TI84006248

In Biology Division. Progress report, August 1, 1982-September 30, 1983.

When the suppressor mutant su(s)^2 of Drosophila melanogaster is present, the effects of four mutations (vermillion, purple, speck, and sable) are alleviated. During the past year our studies have shown that (1) the defective step for the purple mutant involves the synthesis of ramiopterin, (2) ramiopterin is an unusual pteridien whose properties are similar to those of 5,6-dihydropteridine, (3) ramiopterin loses one or more hydrogens on conversion to a closely related metabolite called X_1, (4) X_1 would be an appropriate precursor for 6-acetylpyrimidodiazepine whose structure we established recently, (5) 6-acetylpyrimidodiazepine has the ability to replace riboflavin for the growth of Lactobacillus casei, and (6) 6-acetylpyrimidodiazepine is quite similar to a chromosphore that is isolated from tumerous lymphoid cells.

29338 (ORNL—6021, pp 28-29) **DNA dosimetry applied to problems in genetic toxicology.** Rahn, R.O.; Sellin, H. Jan 1984. NTIS, PC A12/MF A01. Order Number DE84006248. TI84006248

In Biology Division. Progress report, August 1, 1982-September 30, 1983.

Studies have been conducted using uv, metal ions, and polyaromatic hydrocarbons as DNA damaging agents. A method has been devised for removing Pt-base adducts from DNA and for separating these adducts chromatographically. This method has been applied to DNA isolated from tissue culture cells treated with cisplatin. The results indicate that a significant (~ 35%) portion of the cisplatin binds in a form which is the same as that found in DNA treated in vitro. This adduct consists of two guanine molecules connected by a platinum atom. A very useful tool in photobiological research has been the substitution of BrdUrd for Thd in DNA. Following radiation, debromination and damage to the sugar phosphate backbone results. However, the actual chemical event responsible for the observed enhanced cell killing is not known. Attempts to answer this question have employed the use of IdUrd instead of BrdUrd, because of certain spectroscopic and chemical advantages. Current research deals with the mechanisms by which the uracil radical formed upon dehalogenation reacts with its environment to pick up a hydrogen atom and form uracil.

29339 (ORNL—6021, pp 31-32) **Regulation of transport systems in cultured mammalian cells.** Cook, J.S.; Fishman, J.B.; Shaffer, C.J.; Weiss, E.R. Jan 1984. NTIS, PC A12/MF A01. Order Number DE84006248. TI84006248

In Biology Division. Progress report, August 1, 1982-September 30, 1983.

Na, K-ATPase is an essential transport enzyme maintained at appropriate levels and in a state of repair by constant turnover of the surface protein. The regulation of turnover is to some degree specific: in normal growth conditions Na, K-ATPase turns over 6 to 10 times faster than the bulk of membrane proteins. When the cells are K-starved its turnover is reduced with no change in the biosynthetic rate. The enzyme is composed of a catalytic subunit (M/sub r/ = 94,000) and a glycosylated subunit (M/sub r/ = 45,000 to 50,000) of unknown function. With an antibody method we can detect the onset of its synthesis 2 min after the addition of tracer. Over the next 5 h it moves through a series of membrane compartments until it enters a compartment that includes the cell surface. Turnover takes place from this compartment at a rate of one set of surface molecules per half generation. After the general labeling of HeLa cell surface sialoglycoproteins they are exchanged with an internal pool twice the size of the cell surface. From this pool the glycoproteins were removed slowly (t/sub 1/2/ = 100 h) and degraded in turnover. By fractionation studies we have followed the pathway for the internalization side of recycling.

29340 (ORNL—6021, pp 35-38) **Protein chemistry and enzyme mechanisms.** Hartman, F.C.; Donnelly, M.I.; Herndon, C.S.; Lee, E.; Stringer, C.D. Jan 1984. NTIS, PC A12/MF A01. Order Number DE84006248. TI84006248

In Biology Division. Progress report, August 1, 1982-September 30, 1983.

Investigations have centered on ribulosebisphosphate carboxylase, which is essential for the photosynthetic assimilation of CO_2 and possesses inherent oxygenase activity accounting for photorespiration (a nonessential, energy-wasteful process that reduces net CO_2 fixation). An understanding of the in vivo modulation of the carboxylase/oxygenase ratio and a determination of whether this ratio can be systematically manipulated by external means are of major significance to agriculture and production of biomass.

29341 (ORNL—6021, pp 41-49) **Comparative mutagenesis.** Epler, J.L.; Larimer, F.W.; Nix, C.E.; Waters, L.C.; Hardigree, A.A.; Kyte, L.M.; Simms, S.I.; Wilkerson, R.D.; Winton, W. Jan 1984. NTIS, PC A12/MF A01. Order Number DE84006248. TI84006248

In Biology Division. Progress report, August 1, 1982-September 30, 1983.

A progress report of the Comparative Mutagenesis group reviewing studies on the genetic effects of energy-related compounds, and estimating possible genetic risks to man.

29342 (ORNL—6021, pp 50-54) **Mammalian cell genetic toxicology.** Hsie, A.W.; Brimer, P.A.; DeMarini, D.M.; Machanoff, R.; Perdue, S.W.; Recio, L.; Schenley, R.L.; Stankowski, L.F.; Tindall, K.R. Jan 1984. NTIS, PC A12/MF A01. Order Number DE84006248. TI84006248

In Biology Division. Progress report, August 1, 1982-September 30, 1983.

Studies on the mechanisms of mammalian gene mutations and/or the mutagenic effects of environmental agents associated with energy technologies are related. Multiphasic mammalian gene mutational systems at the molecular, cellular and animal levels to help elucidate these mechanisms have been used.

29343 (ORNL—6021, pp 62-66) **DNA repair in human cells.** Regan, J.D.; Carrier, W.L.; Kusano, I.; Van Houten, B.; Dunn, W.C. Jr.; Francis, A.A.; Charp, P.A. Jan 1984. NTIS, PC A12/MF A01. Order Number DE84006248. TI84006248

In Biology Division. Progress report, August 1, 1982-September 30, 1983.

Ultraviolet light induces dimer formation between adjacent pyrimidines in DNA of cells resulting in a variety of deleterious effects. We have studied the uv-light induction and excision of pyrimidine dimers in the DNA of mammalian cells. The number and kinds of dimers formed in DNA is related to the wavelength of uv-light, pyrimidine content, and the total dose. In human cells, a low dose of 254 nm light produces cytosine-cytosine, cytosine-thymidine and thymidine-thymidine dimers at a ratio of 16:24:60 while a low dose of simulated sunlight produces dimers at a ratio of 20:40:40. Normal human cells are able to excise 10^6 dimers from their DNA in a day following irradiation with 254 nm light or simulated sunlight. Inhibitors of DNA synthesis (hydroxyurea and cytosine arabinoside) also have an effect on the excision repair of pyrimidine dimers. Repair processes for uv-induced DNA damage may provide a model for the study of DNA damage by chemical and by other physical agents which result in mutagenesis and carcinogenesis in mammalian cells.

29344 (ORNL—6021, pp 67-68) **Genetic analysis of DNA repair in man with cell hybrids.** Regan, J.D.; Dunn, W.C. Jr.; Francis, A.A.; Lalley, P.A.; Allen, B.E. Jan 1984. NTIS, PC A12/MF A01. Order Number DE84006248. TI84006248

In Biology Division. Progress report, August 1, 1982-September 30, 1983.

We have employed man x mouse somatic cell hybrids as our experimental system and bromodeoxyuridine photolysis, radiochromatography and molecular weight analysis as our assays for DNA repair. The use of somatic cell hybrids allows for the mapping of genes to specific human chromosomes and the genetic dissection of this polygenic system due to the isolation of its component parts as a result of the preferential segregation of human chromosomes in proliferating human x mouse somatic cell hybrids.

29345 (ORNL—6021, pp 155-159) **Molecular genetics of carcinogenesis.** Yang, W.K.; Tennant, R.W.; Boone, L.R.; Brown, A.; Cu, C.Y.; Furkes, R.; Gardner, M.; Koh, C.K.; Kuemmerle, N.; Myer, F.E. Jan 1984. NTIS, PC A12/MF A01. Order Number DE84006248. TI84006248

In Biology Division. Progress report, August 1, 1982-September 30, 1983.

Research efforts are focused on isolation and characterization of germ-line associated heritable retrovirus-like genes which are not known to come out of the cell as a virus, and yet contain structural features characteristic of a movable gene element. BALB/c mouse DNA has been used as a source for risolating several such individual genes as recombinant DNA clones. Restriction endonuclease mapping revealed that the 10.5 kbp EcoRI insert consists of a 3.6 kbp left flanking cellular DNA region and a 6.9 kbp MuLV related region that has a typical proviral LTR-gag-pol-env structure up to the EcoRI site in the env gene region. Comparison of the AL-10 map with ecotropic and xenotropic virus isolates revealed many common restriction sites in the LTR and pol gene regions, but much fewer in the leader gag region. A stretch of 1700 nucleotides containing the cell provirus junctional region was sequenced and revealed transcriptional consensus signals and other structural features characteristic of MuLV LTRs, as well as two distinctive features.

29346 **(SSRL—83/04) X-ray absorption studies of the molybdenum site of nitrogenase.** Conradson, S.D. (Stanford Univ., CA (USA). Stanford Synchrotron Radiation Lab.). Nov 1983. Contract AC03-82ER13000. 360p. NTIS, PC A16/MF A01; 1; GPO Dep. Order Number DE84012741.

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The analysis of the molybdenum absorption edge region of the different states of nitrogenase indicated that the first coordination sphere of the Mo is composed of a combination of hard and soft ligands, as in the $MoFe_3S_4$ cubane-type clusters with three 0 ligands. It also suggested that this type of structure was conserved in the three different states of nitrogenase examined. However, qualitative comparisons of the EXAFS and their Fourier transforms demonstrated that the Mo sites in these three states are unique, and further suggested that the differences in their structures occurred in all three scattering shells. Curve fitting the EXAFS provided some information on the Mo-scatterer distances and numbers, but, because of discrepancies in the values obtained by fitting the EXAFS from different samples of the same state, does not, by itself, provide definitive information. 318 references, 38 figures, 45 tables.

29347 **(SSRL—84/03) X-ray absorption studies of metalloprotein structure: cytochrome P-450, horseradish peroxidase, plastocyanin and laccase.** Penner-Hahn, J.E. (Stanford Univ., CA (USA). Stanford Synchrotron Radiation Lab.). Mar 1984. Contract AC03-76SF00515. 233p. NTIS, PC A11/MF A01; 1; GPO Dep. Order Number DE84011318.

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Extended x-ray absorption fine structure (EXAFS) has been developed to determine the structure of metalloproteins. EXAFS data have been collected and analysed for four states in the catalytic cycle of bacterial cytochrome P-450/sub CAM/. This data demonstrates that sulfur is retained as an axial ligand in the reduced forms of the enzyme. EXAFS and edge data have been analysed for the high-valent states of horseradish peroxidase (HRP), and for high-valent iron-porphyrin model compounds. These data provide the first direct confirmation of the presence of a ferryl Fe=O coordination in HRP and in some of the model compounds. The polarized single-crystal EXAFS spectra of plastocyanin have been measured as a function of both orientation and temperature. These data demonstrate that at room temperature the relative motions of the Cu and the S(Met) are essentially uncorrelated.

29348 **Purification and properties of NAD-dependent 5,10-methylenetetrahydrofolate dehydrogenase from Acetobacterium woodii.** Ragsdale, S.W.; Ljungdahl, L.G. (Univ. of Georgia, Athens). *Journal of Biological Chemistry;* **259**: No. 6, 3499-3503(25 Mar 1984). Contract AS09-79ER10499.

An NAD-dependent 5,10-methylenetetrahydrofolate dehydrogenase has been purified to homogeneity from autotrophically and heterotrophically grown cells of Acetobacterium woodii. The enzymes from the differently grown cells were indistinguishable by gel filtration and sodium dodecyl sulfate electrophoresis and have a final specific activity of 670 units mg^{-1}. The enzyme is oxygen-labile; therefore, it was isolated under anaerobic conditions in the presence of dithiothreitol. The oxidized enzyme can be reactivated with 5 mM dithiothreitol, the half-time of activation being 19 min. The forward and reverse reaction initial velocity kinetics was studied and the enzyme was found to follow a substituted reaction mechanism. With this model, the K/sub m/ values for NAD and 5,10-methylenetetrahydrofolate are 4.0 and 0.26 mM, while for NADH and 5,10-methenyltetrahydrofolate, they are 2.0 and 1.0 mM, respectively. The equilibrium constant at pH 6.7, determined by the Haldane relationship, is approximately equal to 2.0, favoring the formation of NADH and 5,10-methenyltetrahydrofolate. The purified enzyme is a M/sub r/ = 55,000 dimer which lacks 10-formyltetrahydrofolate synthetase and 5,10-methenyltetrahydrofolate cyclohydrolase activities. At pH 6.7, the conversion of 5,10-methylenetetrahydrofolate to 5,10-methenyltetrahydrofolate occurs at a rate of 98,600 mol min^{-1} mol^{-1} of enzyme, while the reverse reaction occurs at a rate of 95,600 mol min^{-1} mol^{-1} of enzyme.

29349 **Born energy problem in bacteriorhodopsin.** Glaeser, R.M.; Jap, B.K. (Univ. of California, Berkeley). *Biophysical Journal;* **45**: No. 1, 95-97(Jan 1984). Contract AC03-76SF00098.

The problem of the electrostatic potential barrier for charge transport across a cell membrane is addressed. Structural studies of bacteriorhodopsin (bR), a transmembrane protein found in Halobacterium halobium, have resulted in substantial evidence for a transmembrane β-sheet domain. It is proposed that a possible function for such a transmembrane domain would be to provide an organic phase pathway for ion transport across the cell membrane. The suggestion that there might be a transmembrane domain of β-sheet in bR first became evident in the high-resolution projection of the crystal structure.

29350 **Biosynthesis of streptothricin F. 5. Formation of β-lysine by Streptomyces L-1689-23.** Thiruvengadam, T.K. (Univ. of Connecticut, Storrs); Gould, S.J.; Aberhart, D.J.; Lin, H.J. *Journal of the American Chemical Society;* **105**: No. 16, 5470-5476(10 Aug 1983).

The formation of the β-lysine moiety of streptothricin F has been studied by feeding to Streptomyces L-1689-23 α-[3-^{13}C,^{15}N]-, α-[(3RS)-$^{3}H_2$]-, α-[(3R)-^{2}H]-, and α-[(3S)-^{2}H]lysine and β-[(2S)-^{2}H]lysine. From the analysis of either the ^{13}C NMR or ^{2}H NMR spectrum of the derived antibiotics, it has been determined that the α-nitrogen migrates to C-3 with inversion of configuration by an intramolecular process, and the 3-pro-R hydrogen migrates to C-2 with inversion of configuration by a process that is substantially or completely intermolecular. The very high degree of incorporation of labeled β-lysine indicates it is probably an intermediate in the biosynthesis of streptothricin F.

29351 **Phycobilisome structure of porphyridium cruentum: polypeptide composition.** Redlinger, T.; Gantt, E. (Smithsonian Institution, Rockville, MD). *Plant Physiology;* **68**: 1375-1379(1981). Contract AS05-76ER04310.

Purified phycobilisomes of porphyridium cruentum were solubilized in sodium dodecyl sulfate and resolved by sodium dodecyl sulfate-acrylamide gel electrophoresis into nine colored and nine colorless polypeptides. The colored polypeptides accounted for about 84% of the total stainable protein, and the colorless polypeptides accounted for the remaining 16%. Five of the colored polypeptides ranging in molecular weight from 13,300 to 19,500 were identified as the α and β subunits of allophycocyanin, R-phycocyanin, and phycoerythrin. Three others (29,000-30,500) were orange and are probably related to the γ subunit of phycoerythrin. Sequential dissociation of phycobilisomes, and analysis of the polypeptides in each fraction, revealed the association of a 32,500 molecular weight colorless polypeptide with a phycoerythrin fraction. The remaining eight colorless polypeptides were in the core fraction of the phycobilisome, which also was enriched in allophycocyanin.

29352 **Identification by peptide analysis of the spectrin-binding protein in human erythrocytes.** Luna, E.J.; Kidd, G.H.; Branton, D. (Harvard Univ., Cambridge, MA). *Journal of Biological Chemistry;* **254**: No. 7, 2526-2532(10 Apr 1979). Contract AC02-76EV02423.

One-dimensional and two-dimensional peptide-mapping techniques are used to identify the protein which gives rise to the 72,000 dalton α-chymotryptic fragment previously shown to be the membrane attachment site for spectrin. Limited proteolysis of erythrocyte membranes is shown to generate Band 3', another polypeptide which has been associated with spectrin-binding activity. It is concluded that Band 2.1 and possibly some or all of the other, related polypeptides which electrophorese in the 2 region is (are) the spectrin-binding protein(s) of the human erythrocyte.

29353 **Lipoprotein lipase: isolation and characterization of a second enzyme species from postheparin plasma.** Fielding, P.E. (Univ. of California, San Francisco); Shore, V.G.; Fielding, C.J. *Biochemistry;* **16**: No. 9, 1896-1900(1977).

A lipoprotein lipase species (mol wt 69 250) has been isolated from rat postheparin plasma, which differs from the low-molecular-weight species previously characterized in its amino acid composition and hexosamine content, and in its lower affinity for triglyceride-rich lipoprotein substrates. However, both enzymes are activated by the same coprotein (C-terminal glutamic acid, apo-C-2) from human very low density lipoprotein and have a similar specificity for lipid esters. Neither purified enzyme is activated by heparin. Both are inhibited by molar sodium chloride. Both enzyme species can be recovered from the same plasma samples. The possible relationship of these proteins to the different functional lipoprotein lipase activities of muscle and adipose tissues is discussed.

5503 Cytology

REFER ALSO TO CITATION(S) 29157, 29334, 29449

29354 **(LBL—17704) Responses of red blood cell-membrane systems: temperature and calcium effects on volume, deformability, and osmotic fragility as studied by resistive pulse spectroscopy.** Richieri, G.V. (Lawrence Berkeley Lab., CA (USA)). Apr 1984. Contract AC03-76SF00098. 192p. NTIS, PC A09/MF A01; 1; GPO Dep. Order Number DE84011515.

Portions are illegible in microfiche products; Thesis.

The effects exerted by temperature and calcium on red blood cells were studied using resistive pulse spectroscopy (RPS). A new RPS protocol is presented which enables cell volume and shape to be determined more accurately than previously possible. Repair processes of the RBC membrane following osmotic hemolysis were examined. 140 references, 44 figures, 6 tables.

29355 (ORNL—6021, pp 32-35) **Theoretical and applied cryobiology.** Mazur, P.; Cole, K.W.; Schneider, U. Jan 1984. NTIS, PC A12/MF A01. Order Number DE84006248. TI84006248

In Biology Division. Progress report, August 1, 1982-September 30, 1983.

The purpose of the Theoretical and Applied Cryobiology Program is to determine the responses of cells to the major cryobiological variables involved in freezing and thawing such as cooling rate, and to the physical state of the cell and its surroundings. Besides freezing studies per se, our research involves a combination of experimental and mathematical approaches to determine the permeability and osmotic responses of cells to critical solutes and water. The cells currently under study are mouse and cattle embryos and human erthrocytes.

29356 (ORNL—6021, pp 79-81) **Drosophila cytology and genetics.** Grell, R.F.; Generoso, E.E. Jan 1984. NTIS, PC A12/MF A01. Order Number DE84006248. TI84006248

In Biology Division. Progress report, August 1, 1982-September 30, 1983.

Meiosis occupies the central position in eukaryotic genetics. It provides for the precise partitioning of the genetic material from the diploid to the haploid amount. Errors which occur in the process are nearly always deleterious and frequently lethal to the progeny. It has been demonstrated unequivocally that synapsis, in the case of the Drosophila oocyte, is incorrectly placed according to the conventional model of meioses. Rather than occurring during prophase, synapsis has begun early in premeiotic interphase and homologues are paired throughout the premeiotic-S phase. To learn how great the requirement is for strict homology in the synaptic process has been attempted.

29357 (ORNL—6021, pp 167-169) **Cytometrics.** Mann, R.; Hand, R.E. Jr. Jan 1984. NTIS, PC A12/MF A01. Order Number DE84006248. TI84006248

In Biology Division. Progress report, August 1, 1982-September 30, 1983.

Histograms frequently consist of several components that show varying degrees of overlap. The main task of histogram analysis is to identify these components. Our major progress has been in the area of analysis of DNA-histograms. The need to analyze DNA-histograms obtained from heterogeneous cell populations led to the formulation of a new method for the identification of histogram components. The method is based on maximum likelihood estimation, and is also applicable to two-parameter histograms.

29358 **Three-color fluorescence measurements on single cells excited at three laser wavelengths.** Steinkamp, J.A.; Stewart, C.C.; Crissman, H.A. (Los Alamos National Lab., NM). *Cytometry (Baltimore);* **2**: No. 4, 226-231(1982).

A three-laser flow cytometer for quantitative analysis and sorting of cells and microscopic particles has been developed and evaluated using argon- and krypton-ion lasers as excitation sources. Cells stained with three fluorescent dyes having different excitation spectra enter a flow chamber where they first pass through an electronic volume sensor and then intersect three spatially separated laser beams for fluorescence excitation of bound dyes and light scatter measurements. Separate pairs of beam-shaping optics independently position and focus each beam onto the cell stream thus permitting cells to be sequentially illuminated. Fluorescence is measured by a detector that employs a single collecting lens for single or multilaser excitation experiments. Fluorescence signals are processed and displayed as frequency distribution histograms using an LSI-11 computer. This instrument is described in detail with illustrative examples using cells stained for DNA content, protein, and cell surface antigens and cells that have phagocytized fluorescent microspheres.

29359 **Identification of mitogen responding lymphocytes by fluorescence polarization.** Udkoff, R.; Chan, S.; Norman, A. (Univ. of California, Los Angeles). *Cytometry (Baltimore);* **1**: No. 4, 265-271(1981).

Measurements of the intensity and polarization distributions of fluorescein fluorescence in human lymphocyte populations show changes within minutes after exposure of the cells to the mitogens phytohemagglutinin and Concanavalin A. The distributions of polarization, which before mitogen exposure show essentially a single peak, after exposure develop a second peak at a lower value of polarization. Simultaneously, the intensity distributions show a shift to higher levels of intensity. These shifts can be modeled on the basis of a subpopulation of lymphocytes responding to mitogen. Interpretation of the results is complicated by many factors that may influence the shape of the polarization distributions. In particular we show that the measurements are sensitive to the concentrations of phytohemagglutinin, Concanavalin A, Ca^{++}, K^{+}, fluorescein diacetate, the incubation time and the specific donor. Nevertheless, fluorescein fluorescence measurements provide a rapid and sensitive method for studying the physiology of lymphocytes and for identifying responding lymphocyte subpopulations.

29360 **Variability in DNA distributions of human neuroblastomas after cyclophosphamide.** Danon, Y.L.; Epstein, M.B.; Siegel, M.M.; Rucker, N.; Myers, C.P.; Norman, A.; Benedict, W.F.; Seeger, R.C. (Univ. of California, Los Angeles). *Cancer Treatment Reports;* **64**: No. 12, 1275-1281(Dec 1980). Contract AM03-76SF00034.

Major changes in DNA distributions of two human neuroblastoma cell lines growing in vitro and in athymic nude mice occurred after treatment with cyclophosphamide. Pulse treatment of LA-N-1 cells in vitro with liver S-9-activated cyclophosphamide caused approximately 50% cytotoxicity; flow microfluorometric analysis of surviving cells demonstrated an increased proportion of G_2 = M cells and a decreased proportion of G_1 cells, particularly at 48 hrs. Even though LA-N-1 tumors in nude mice did not regress after one dose of cyclophosphamide, the percent of G_2 + M cells increased and the percent of G_1 cells decreased 4-6 days after treatment; the percent of cells in S increased at 2 and again at 8 days. SK-N-MC cells were affected differently by cyclophosphamide. Pulse treatment of these cells in vitro with liver S-9-activated cyclophosphamide caused > 85% cytotoxicity and nearly complete elimination of cells in G_2 + M at 24 and 48 hrs. Likewise, SK-N-MC tumors in nude mice regressed > 50% after cyclophosphamide, and the proportion of G_2 + M cells decreased markedly 2-6 days after therapy.

29361 **Similarity of satellite DNA properties in the order Rodentia.** Mazrimas, J.A.; Hatch, F.T. (Lawrence Livermore Lab., CA). *Nucleic Acids Research;* **4**: No. 9, 3215-3227(Sep 1977). Contract W-7405-ENG-48.

Satellite DNAs from 9 species of kangaroo rat (Dipodomys) have been characterized and have shown that the HS-α and HS-β satellites, where present, are nearly identical in all species as to melting transition midpoint (Tm), and density in neutral CsCl, alkaline CsCl, and Cs_2SO_4-Ag^{+} gradients. However, the MS satellites exist in two internally similar classes. The satellite DNAs from three other rodents were characterized (densities listed are in neutral CsCl). The pocket gopher, Thomomys bottae, contains Th-α (1.713 g/ml) and Thβ (1.703 g/ml). The guinea pig (Cavia porcellus) contains Ca-α, Ca-β and Ca-γ at densities of 1.706 g/ml, 1.704 g/ml and 1.704 g/ml, respectively. The antelope ground squirrel (Ammospermophilus harrisi) contains Am-α, 1.708 g/ml, Am-β, 1.717 g/ml, and Am-γ, 1.707 g/ml. The physical and chemical properties of the alpha-satellites from the above four rodents representing four different families in two suborders of Rodentia were compared. They show nearly identical Tm, nucleoside composition of single strands, and single strand densities in alkaline CsCl. Similar comparisons on the second or third satellite DNAs from these rodents also indicate a close relationship to each other. Thus the high degree of similarity of satellite sequences found in such a diverse group of rodents suggests a cellular function that is subject to natural selection, and implies that these sequences have been conserved over a considerable span of evolutionary time since the divergence of these rodents about 50 million years ago.

29362 **Clonal variation in colony morphology and growth of CHO cells cultured on agar.** Konrad, M.W. (Univ. of California, Berkeley); Storrie, B.; Glaser, D.A.; Thompson, L.H. *Cell;* **10**: 305-312(Feb 1977).

Single Chinese hamster ovary (CHO) cells plated on agar form macroscopic colonies with high efficiency. Colonies produced by cells from the uncloned cell line increase in diameter continuously for 10-12 days after plating to form mounds of cells about 1 mm in diameter. With further incubation, some of these colonies do not increase in diameter (arrested dome), some form an expanding annular monolayer of cells around the central mound (fried egg), and some grow by enlarging the central mound into a low multilayered disc (saucer). These colony types on agar appear to be clonal characteristics of the CHO cell line. Cloning the line gives two kinds of isolates: one forms a mixture of arrested dome and fried egg colonies in an inheritable ratio, and the other forms saucer colonies. Cells from saucer colonies form saucer colonies when replated on agar. Cells from all colony types replate with similar efficiency on plastic or agar, and exhibit the same growth rate and cell size in liquid suspension culture. On plastic substrate, all these CHO cells form colonies which increase continuously in diameter for as long as 21 days, and little clonal difference in the morphology of colonies or of single cells is observed. These observations reveal a previously unsuspected heterogeneity in an established line of cultured mammalian cells and provide a method for studying new classes of in vitro growth control phenomena. These control phenomena may help in the building of an in vitro model for tumor growth.

29363 **Flow cytometric analysis of bromodeoxyuridine-substituted cells stained with 33258 Hoechst.** Latt, S.A. (Childrens Hospital Medical Center, Boston, MA); George, Y.S.; Gray, J.W. *Journal of Histochemistry and Cytochemistry;* **25**: No. 7, 927-934(1977). Contract W-7405-ENG-48.

The paper describes a flow-cytometric application of the quenching of fluorescence from 33258 Hoechst stained Chinese hamster ovary-line cells due to the incorporation of 5-bromo-deoxyuridine (BrdU) into the cellular deoxyribonucleic acid. Cells were grown for 24 hr in medium containing BrdU in concentrations ranging from 1×10^{-6} to 1×10^{-4} M. For each concentration the average fluorescence was measured as determined by flow cytometry, the extent of BrdU substitution and the effect of the BrdU on cell growth. BrdU concentrations of 1×10^{-5} M resulted in sufficient substitution to quench the fluorescence from 33258 Hoechst by a factor of 4, allowing discrimination between cycling and noncycling cells. The extent of BrdU substitution after growth for 24 hr in this concentration of BrdU was 64%. These data indicate the feasibility of detecting deoxyribonucleic acid synthesis in whole cells using the 33258 Hoechst-BrdU methodology.

29364 Stable, near-haploid mammalian cell line (Dipodomys ordii). Bostock, C.J. (MRC Clinical and Population Cytogenetics Unit, Edinburgh, Scotland); Christie, S.; Hatch, F.T.; Mazrimas, J.A. *Experimental Cell Research;* **106**: 373-377(1977). Contract W-7405-ENG-48.

A$_{1}$ established SV40-transformed cell line of Dipodomys ordii was cloned for selective loss of chromosomal material. A clone is described which has a modal chromosome number of 50 (in the normal diploid 2n = 72), and has about 66% of the DNA content of normal diploid cells. Karyotype anlysis shows that, although some chromosome rearrangement has taken place, 23 chromosomes are completely unpaired and 7 chromosomes are partially unpaired. Buoyant density analysis in neutral CsCl and Cs_2SO_4 + Ag gradients of the DNA of this clone shows that there has been no selective retention or loss of any of the satellite DNA components present in D. ordii during the elimination of 34% of the genetic material.

29365 Strategies for choosing a deoxyribonucleic acid stain for flow cytometry of metaphase chromosomes. Jensen, R.H.; Langlois, R.G.; Mayall, B.H. (Lawrence Livermore Lab., CA). *Journal of Histochemistry and Cytochemistry;* **25**: No. 8, 954-964(1977). Contract W-7405-ENG-48.

Requirements for flow cytometry of metaphase chromosomes stained with three deoxyribonucleic acid (DNA)-specific fluorescent dyes - Hoechst 33258, Chromomycin A$_3$, and ethidium bromide - are reviewed. Fluorescence properties of these three stains when bound to mitotic cells or to chromosomes in suspension are measured and compared with fluorescence properties when bound to DNA in solution. Conditions are given for high resolution flow cytometry of Chinese hamster chromosomes stained with each of the fluorophors, and histograms are presented that exhibit differences in relative peak position and area. Energy transfer fluorescence between two DNA stains is presented as a potentially useful new parameter for flow cytometry of chromosomes and is illustrated by fluorescence energy transfer from Chromomycin A$_3$ to ethidium bromide when simultaneously bound to hamster mitotic cells.

29366 Chromosomes of antelope squirrels (genus Ammospermophilus): a systematic banding analysis of four species with unusual constitutive heterochromatin. Mascarello, J.T. (Univ. of California, Berkeley); Mazrimas, J.A. *Chromosoma;* **64**: 207-217(1977).

The G- and C-banding patterns of mitotic chromosomes from four species of antelope squirrels (Ammospermophilus harrisi, interpres, leucurus and nelsoni) are discussed with special attention payed to the unusual quantities and position of constitutive heterochromatin. Heterochromatin appears to be responsible for the observation that cells from antelope squirrels contain over 70% more DNA than cells from another ground squirrel. A substantial fraction of this excess DNA consists of sequences that band as satellites in neutral CsCl or Cs_2SO_4 - Ag^+ density gradients. Interspecies similarities in the distribution of heterochromatin suggest that it has a function of some importance to these species and has therefore been conserved.

29367 Interaction of Hoechst 33258 and BrdU substituted DNA in the formation of sister chromatid exchanges. Stetka, D.G.; Carrano, A.V. (Lawrence Livermore Lab., CA). *Chromosoma;* **63**: 21-31(1977). Contract W-7405-ENG-48.

Sister chromatid exchanges (SCEs) are induced in cultured Chinese hamster cells by treatment with 5-bromodeoxyuridine (BrdU) or with Hoechst 33258 (H33258) plus BrdU. The SCE frequencies depend upon the number of H33258 molecules available per cell (or per base pair) and the number of BrdU molecules available per cell, and not solely upon molarity. In addition, H33258 and BrdU act synergistically to induce SCEs. At low BrdU concentrations H33258 induces very few SCEs. At high BrdU concentrations and similar concentrations of H33258, however, SCE frequencies are significantly increased. SCE frequencies decrease with time in successively harvested cells because of the depletion of H33258 from the medium due to DNA binding.

29368 Chromomycin A$_3$ as a fluorescent probe for flow cytometry of human gynecologic samples. Jensen, R.H. (Lawrence Livermore Lab., CA). *Journal of Histochemistry and Cytochemistry;* **25**: No. 7, 573-579(1977). Contract W-7405-ENG-48.

Chemical, physical and optical properties of chromomycin A$_3$ are examined so as to ascertain appropriate staining and analysis procedures for flow cytometry of human gynecologic samples. Fluorescence excitation and emission spectra of chromomycin A$_3$-stained cervical cells are compared with those of chromomycin a$_3$-stained deoxyribonucleic acid. Conditions for deoxyribonucleic acid-specific staining of cervical cells are presented, and staining specificity of cervical cells with chromomycin A$_3$ is compared to that obtained with ethidium bromide, propidium iodide and Hoechst 33258. Also presented is a brief review of two parameter flow cytometry as a prescreening procedure for detection of cervical neoplasia. Results of flow cytometry and cell sorting are interpreted based on the deoxyribonucliec acid-specificity of chromomycin A$_3$ staining.

5504 Genetics

REFER ALSO TO CITATION(S) 29322, 29326, 29337, 29341, 29342, 29343, 29344, 29356, 29443

29369 (ORNL—6021, pp 68-69) Genetic dissection of DNA repair in xeroderma pigmentosum cells. Lalley, P.A.; Diaz, J.A.; Regan, J.D.; Dunn, W.C. Jr.; Francis, A.A. Jan 1984. NTIS, PC A12/MF A01. Order Number DE84006248. TI84006248

In Biology Division. Progress report, August 1, 1982-September 30, 1983.

Xeroderma pigmentosum (XP) demonstrates direct linkage between defective repair of damaged DNA and induction of mutations or cancers. Studies utilizing the fusion of XP cells from unrelated patients have indicated that excision defective cells can be classified into at least seven different complementation groups, designated A through G. This genetic heterogeneity in XP is perplexing since the biochemical lesion is thought to be an endonuclease which initiates excision of uv-induced pyrimidine dimers. An elucidation of the basis for the genetic heterogeneity of XP is necessary if the functional relationships between DNA repair, mutagenesis, and carcinogenesis. When the XP x mouse hybrid cells were analyzed for repair ability, it was found that mouse cells complemented the defective repair in four XP complementation groups i.e., A, B, C, D. The genetic defect in Group E is different from that found in the other groups. In XP-A x mouse hybrids, there is a strong correlation between the presence of chromosome 14 and the ability to be complemented and the loss of complementation and the loss of chromosome 14. In XP-B x mouse hybrids there is a correlation between the presence of chromosome 3 and complementation and absence of chromosome 3 and the loss of complementation. Chromosome 14 may also be associated with complementation since only one clone in the XP-B x mouse hybrids was discordant for complementation and chromosome 14.

29370 (ORNL—6021, pp 70-75) Genetic basis of mutagenesis and carcinogenesis. Lalley, P.A.; Allen, B.E.; Braden, P.; Moore, K. Jan 1984. NTIS, PC A12/MF A01. Order Number DE84006248. TI84006248

In Biology Division. Progress report, August 1, 1982-September 30, 1983.

This study aims to investigate the genes important for susceptibility to mutagens and carcinogens whether they be physical, chemical or biological agents; to identify, characterize and determine the chromosomal assignment of these genes; and to investigate the linkage relationships of homologous genes in man, mouse and other species. Comparative mapping data are used to extrapolate biological and biomedical data from laboratory animals to man. These studies are being pursued utilizing somatic cell hybrids for the genetic dissection of complex polygenic traits by isolating their component parts, and the determination of gene-chromosonal assignments due to preferential chromosome segregation.

29371 **Complete nucleotide sequence of bacteriophage T7 DNA and the locations of T7 genetic elements.** Dunn, J.J.; Studier, F.W. (Brookhaven National Lab., Upton, NY). *Journal of Molecular Biology;* 166: 477-535(1983).

The complete nucleotide sequence of bacteriophage T7 DNA, 39,936 base-pairs, has been determined by the techniques of Maxam & Gilbert. All previously known T7 genes and several unsuspected genes have been identified in the sequence. In addition, five potential overlappng genes have been identified, and there is preliminary evidence that one of them is expressed. Where gaps between coding sequences are found, they usually are less than 100 basepairs long, and usually contain one or more transcription signals, RNAase III cleavage sites, or origins of replication. Transcription signals in the T7 DNA include the three strong early promoters and the early termination site for Escherichia coli RNA polymerase, and 17 promoters and one termination site for T7 RNA polymearse. Ten RNA ase III cleavage sites have been located, five in the early region and five in the late region. The primary transcripts are processed at these sites to provide the messenger RNAs observed in vivo. Almost all of the T7 messenger RNAs are polycistronic, but there are few polar effects at the level of transcription and most T7 proteins seem to be initiated independently, each from its own ribosome-binding and initiation site. The amino acid sequences and composition predicted for all of the T7 proteins (except the proteins produced by frameshifting) are given. T7 DNA begins and ends with a perfect direct repeat of 160 base-pairs. Immediately adjacent to this terminal repetition, at both ends of the mature DNA, lie very similar, regular arrays of 12 imperfect copies of a seven-base sequence. In the concatemeric form of T7 DNA, a single copy of the terminal repetition is flanked by these two arrays of repeated sequences, and it seems likely that this arrangement is involved in formation of the ends of mature T7 DNA.

29372 **Geometry and evolution.** Findley, G.L.; McGlynn, S.P. (Louisiana State Univ., Baton Rouge). *International Journal of Quantum Chemistry, Quantum Biology Symposium;* No. 8, 455-461(1981).

A field-theoretic treatment of biological evolution is presented. This treatment (evolutionary field theory) leads to the decomposition of biological evolution, at the molecular level, into permutational and substitutional evolution. The mathematical distinction between these latter two types of evolution is investigated and a nonlinear/linear classification results.

5505 Metabolism

REFER ALSO TO CITATION(S) 29257, 29341, 29402, 29404, 29491, 29494, 29499

29373 (ORNL—6021, pp 119-120) **Analyses of specific regions of the mouse genome.** Russell, L.B.; Montgomery, C.S.; Mendel, J.; Albritton, L. Jan 1984. NTIS, PC A12/MF A01. Order Number DE84006248. TI84006248

In Biology Division. Progress report, August 1, 1982-September 30, 1983.

In a continuation of the genetic analysis of specific chromosomal regions of the mouse, a study of mutations involving the p (pink-eye) locus have been initiated. P is on Chromosome 7 about 14 cM proximal to c. Over 170 p-locus mutants have been analyzed as to heterozygous and homozygous phenotype and mode of origin. The p-locus study has already revealed some complementations for lethal effects. A number of p locus lethals have also been screened for lactate-dehydrogenase-A expression by gel electrophoresis, followed by measures of enzyme activity. The p mutant that is deficient for ru-2 was found to be deficient for Ldh A as well.

29374 (ORNL—6021, pp 120-121) **Synaptonemal complex study of nonhomologous synapsis in X-autosome translocations sheds light on X-Y disjunction mechanisms.** Ashley, T.; Russell, L.B. Jan 1984. NTIS, PC A12/MF A01. Order Number DE84006248. TI84006248

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During pachytene, the X and Y chromosomes have a region of synapsis (involving up to 35% of the distal portion of the X), as well as unsynapsed, or differentiated regions. The finding that the X - both in its differentiated and in its (normally) Y-pairing portions - is capable of nonhomologous synapsis with an autosome casts doubt on the homology of X-Y synapsis.

29375 (ORNL—6021, pp 121-122) **Involvement of the Y chromosome in translocations.** Cacheiro, N.L.A. Jan 1984. NTIS, PC A12/MF A01. Order Number DE84006248. TI84006248

In Biology Division. Progress report, August 1, 1982-September 30, 1983.

Although it is well known that reciprocal translocations involving the X chromosome cause complete sterility in male carriers in the balanced state, effects of translocations involving the Y chromosome are not well understood. In the course of our studies on sterility in male progeny from mutagen treated male parents we found 34 translocations involving the Y chromosome, which represents about 30% of all male-sterile translocations. A mapping of Y-chromosome breakpoints in banded preparations shows the distribution to be more or less random, with a slight concentration in the middle of the chromosome.

29376 (ORNL—6021, pp 123) **High-resolution banding of mouse prometaphase-prophase chromosomes.** Cacheiro, N.L.A. Jan 1984. NTIS, PC A12/MF A01. Order Number DE84006248. TI84006248

In Biology Division. Progress report, August 1, 1982-September 30, 1983.

Recent technical advances in the high-resolution banding of human chromosomes from lymphocyte cultures have provided a valuable tool for increasing the accuracy in the analysis of breakpoints, and for a better definition of chromosomal rearrangements. The technique has been used in conjunction with BrdU in the study of inactivation patterns of a number of our X-autosome translocations.

29377 (ORNL—6021, pp 124-125) **Mechanism of genetic suppression.** Grell, E.H.; Jacobson, K.B. Jan 1984. NTIS, PC A12/MF A01. Order Number DE84006248. TI84006248

In Biology Division. Progress report, August 1, 1982-September 30, 1983.

The term, suppressor, is used to denote a mutation that reverses the effects of a mutation in a gene located elsewhere. The suppressor locus that has most intensively been examined is su(s). It suppresses vermillion, sable, speck, and purple alleles. Concentration has been on the suppression of mutations of the pr locus (purple). The pr^+ allele specfies the structure of a component of sepiapterin synthase. The enzyme catalyzes a reaction that is in the synthetic pathway of the red pteridine pigments of Drosophila eyes. The effect on eye color is an indicator of changes in the enzyme activity.

29378 (ORNL—6021, pp 144-146) **In vitro studies of cutaneous toxicity and chemical-skin interactions.** Kao, J.Y.; Hall, J.W.; Whitaker, M.J. Jan 1984. NTIS, PC A12/MF A01. Order Number DE84006248. TI84006248

In Biology Division. Progress report, August 1, 1982-September 30, 1983.

The objectives of this research were to develop a better understanding of the factors involved in the interaction of chemicals with the skin and subsequent toxic responses, to identify possible biochemical and functional parameters for toxicity quantitation, and to develop a quantitative basis for extrapolation from animal to man. Our experimental approach is to make use of in vitro methods utilizing mammalian skin in organ culture. Two systems for maintaining metabolically viable and structurally intact mouse skin as short term organ cultures (24 to 48 hours) are being used.

29379 (ORNL—6021, pp 169-173) **Metabolic activation and carcinogen metabolism.** Selkirk, J.K.; Tong, S.; Mansfield, B.K.; Noghrei-Nikbakht, P.A. Jan 1984. NTIS, PC A12/MF A01. Order Number DE84006248. TI84006248

In Biology Division. Progress report, August 1, 1982-September 30, 1983.

Studies have been designed to carefully define the metabolic differences in diverse tissues for the activation and detoxification of polycyclic carcinogens. Benzo(a)pyrene is being used as the proto-

type molecule to formulate a mechanism which describes how individual systems transform the parent chemical into a highly reactive electrophile.

5506 Medicine

REFER ALSO TO CITATION(S) 29416, 29458

29380 (DOE/CE/25082—T1) Karlson ozone sterilizer. Final report. Karlson, E. (Life Support Systems, Erie, PA (USA)). 7 May 1984. Contract FG01-82CE25082. 110p. Life Support Systems, 4634 State St., Erie, PA 16509. Order Number DE84011489.

The authors have a functional sterilization system employing ozone as a sterilization agent. This final report covers the work that led to the first medical sterilizer using ozone as the sterilizing agent. The specifications and the final design were set by hospital operating room personnel and public safety standards. Work on kill tests using bacteria, viruses and fungi determined the necessary time and concentration of ozone necessary for sterilization. These data were used in the Karlson Ozone Sterilizer to determine the length of the steps of the operating cycle and the concentration of ozone to be used. 27 references.

29381 (DOE/ER/60084—3) Development of the Osmium-191->Iridium-191m radionuclide generator. Annual report. Treves, S.; Packard, A. (Harvard Medical School, Boston, MA (USA)). May 1984. Contract AC02-82ER60084. 31p. NTIS, PC A03/MF A01; GPO Dep. Order Number DE84012460.

The use of the ultrashort-lived radionuclide IR-191m (T/sub 1/2/=5s) for radionuclide angiography results in a lower patient radiation dose, higher photon flux, and allows repeated studies that are not possible with the radionuclide currently employed for these studies (Tc-99m, T/sub 1/2/=6h). The Os-191->Ir-191m generator currently being used in clinical studies suffers, however, from low Ir-191m yield (10%), high Os-191 breakthrough (5 x 10^{-3}%), and an eluent (at pH 1) that must be buffered prior to injection. Initial efforts to improve the performance of this generator met with only limited success. We have, therefore, concentrated on the development of a completely new generator system. In the last year these investigations have led to a new generator of improved Ir-191m yield (20 to 25%), dramatically lower Os-191 breakthrough (5 x 10^{-4}%), and an eluent that does not require buffering prior to injection. In addition, this generator has been found to be stable for at least 10 days and does not require a scavenger column to achieve low breakthrough. Clinical studies have continued at Children's Hospital in pediatric patients and at Beth Israel Hospital in adult patients. 19 references, 1 figure, 10 tables.

29382 (FRNC-TH—1392) Dosimetry and quality control in radiodiagnosis. Le Gouic, M. (Toulouse-3 Univ., 31 (France)). Jul 1983. 118p. (In French). NTIS (US Sales Only), PC A06/MF A01. Order Number DE84750607.

This work deals with physics of radiodiagnosis. In a first part a study of the characteristics of different kinds of radiological equipments and a quality assurance of some of them (standard radiography, coronarography and computed tomography) have been performed. The second part deals with patient irradiation. After a bibliographic study of radiodiagnosis dosimetry, two kinds of dosimetric measures have been made: "in vitro" measures, using a phantom, that had allowed to calibrate the equipment and to improve the individual irradiation card, and "in vivo" measures. For the first types of measures ionization chambers, have been used for the second thermoluminescent dosimeters.

29383 (HRP—0904756/4) Report and recommendtions of the nuclear magnetic resonance advisory committee, Georgia Statewide Health Coordinating Council. (Georgia Health Planning and Development Agency, Atlanta (USA)). Aug 1983. 19p. NTIS, PC A02/MF A01.

Nuclear Magnetic Resonance (NMR) imaging is a new, rapidly evolving technology which is expected to dramatically influence the diagnostic capbility of Georgia's medical community over the next few years. This report is made up of two distinct components. The first component familiarizes the reader with basic concepts and issues surrounding NMR technology. The second component summarizes the activity and recommendations of the Statewide Health Coordinating Council's Nuclear Magnetic Resonance Advisory Committee.

29384 (INIS-mf—8376) Radiotherapy of tumors of the salivary glands. Tressel, W. (Muenchen Univ. (Germany, F.R.)). 24 Apr 1979. 91p. (In German). NTIS (US Sales Only), PC A05/MF A01. Order Number DE84780198.

85% of 91 irradiated tumors were malign, 12% were pleomorphic adenomas and 3% were benign. 70% were primary tumors, 30% were relapses. Two thirds of all tumors were carcinomas. More than the half of the local irradiations were performed with cobalt 60, one third with accelerator, and the remaining ones with conventional or ultrahard X-rays. Focal dosages were 4000 to 6000 rd in 4 to 7 weeks. In the pleomorphic adenomas a high relapse rate was observed (3/11). These tumors should postoperatively receive a focal dosage of 5000 rd over a period of 5 to 6 weeks. 29 of the 43 postoperatively X-irradiated malign primary tumors reached the two-year-limit. In 10% advanced relapses occurred. If a tumor is removed of a healthy body, 5000 rd over 5 weeks will suffice as postoperative X-irradiation. When signs of particular malignity are apparent, the dosage is to be increased. The weekly dosage should range between 800 and 1000 rd. The results of primary irradiation were very bad. For inoperable tumors more than 6000 rd focal dosage will probably be required. In all cases of malign tumors the ipsilateral side of the neck should be irradiated as prophylactic measure, even if palpation does not indicate any suspectable lymphatic nodes. For this 5000 rd focal dosage should suffice. In 56% of all patients metastases were found. The survival rate of 5 years was 56% in pleomorphic adenomas, in carcinomas in total 24%, in adenoid cystic carcinomas alone 67%. Relapses show a significantly worse prognosis than primary tumours. For the postoperatively irradiated primary tumors the survival rate of 5 years was 48%, for the exclusively irradiated relapses only 17%. (orig./MG).

29385 (INIS-mf—8377) Results of 1,886 choledochal surgeries under particular consideration of intraoperative routine cholangiography with contrast media providing different degrees of density. Koch, M. (Duesseldorf Univ. (Germany, F.R.). Medizinische Fakultaet). 1979. 75p. (In German). NTIS (US Sales Only), PC A04/MF A01. Order Number DE84780194.

The results are demonstrated of intraoperative routine cholangiography with radiographic contrast media with different degrees of density which are illustrated by 1,886 medical records of biliary tract surgery performed between 1968 and 1977. Choledochotomy was realized in 16.6%, transcystical cholangiograms were made in 40.5% of the cases. Safety choledochotomy was applied in only 22.4%, in spite of low radiographic rates. With the false positive probe cholangiograms conray resulted to be superior to biligrafin. None of the individual conray concentrations resulted to be the best with regard to false positive misinterpretations. Clinically unsuspected concrements were detected with conray 15 in the most cases (3,6%). With the false negative probe cholangiograms conray 15 resulted to be superior. The same ratios resulted for relapse therapy. For choledochotomy conray 15 was applied in vain in only 33.3% of all cases of intraoperative T-draining radiography, the other contrast media in 50%. Summarizing it can be said that the best results were obtained with conray 15. Moreover, the findings of secondary surgery are described, the more rarely occurring outflow obstructions due to concrements are depicted and the intraoperative concrement sites are indicated. Finally, the postoperative treatment of choledochotomies, the amount of postoperative complications is indicated and the mortality rates for every kind of surgery and the individual age groups are given. (orig./MG).

29386 (INIS-mf—8380) Results of scintigraphic goiter diagnostics of 1975 and 1976. Holtz-Zettler, F. (Tuebingen Univ. (Germany, F.R.). Medizinische Fakultaet). 1980. 51p. (In German). NTIS (US Sales Only), PC A04/MF A01. Order Number DE84780195.

In 2,790 scintiscans of the thyroid gland the distribution of cold, cool, warm and hot nodules and of diffuse goiters was assessed. In 276 scintiscanned patients who underwent operation, classification based on the following criteria: nodule type, palpation, malignancy rate, histology, age and sex. In addition, the occurrence of hyper- and hypothyreosis was investigated. For cold nodules the malignancy rate was 13.7%, for cool nodules 7.7%, for warm nodules 2.7%, and for diffuse goiters 7%; hot nodules didn't show malignant growth. In 9% of all operated preparations malignant degenerations were found; the removed nodular goiters comprised 9.3%. Among all nodules the incidence was 2.2%; 4.6% of all cold nodules were malign. In 20% of all patients with cancer metastases were found; their most frequent localisations were the regional lymphatic nodes. Histologically papillary and follicular carcinomas resulted to be the most frequent carcinomas (36% each); the incidence of anaplastic carcinomas was 20%. Medullary carcinoma and sarcoma were diagnosed once each. In females benign nodules occured more than four times, diffuse goiters and cold malignomas almost three times as much as in males. In both sexes the most benign modules were found between the 50th and 70th year of life, and particularly in the 7th decade of life. Toxic adenomas occurred particularly in women up to 35 years and at the beginning of the 8th decade of life. (orig.).

29387 **(INIS-mf—8382) Scintigraphy of the interior of the heart. Studies on the calculation of ejection fractions from first passage and equilibrium studies.** Bluhm-Kudlacek, G. (Tuebingen Univ. (Germany, F.R.). Medizinische Fakultaet). 1981. 81p. (In German). NTIS (US Sales Only), PC A05/MF A01. Order Number DE84780196.

A technique of nuclear medical heart diagnosis developed at the department of Nuclear Medicine of the University of Tuebingen (Prof. Dr. Feine) was further developed in this work and examined with respect to uncertainty factors. The main interest was the ejection-fraction of the left ventricle as an important parameter of heart action. After the evaluation of 21 cases, all possible sources of errors in the calculation of the ejection fraction form the first passage of activity were examined systematically. The results of the test program were checked in a second evaluation of the case studies. As a result a concept is proposed that should yield reliable and compatible values in future investigations: the demarcation of the region of interest of the left ventricle (ROI) by means of a representative cycle or by accepting a ROI that was identified by a special computer program out of the equilibrium study, the left boundary of the correction area for background correction in the maximum of the background activity time-activity characteristic, a two-fold smoothing of left ventricular and background time-activity characteristic, the use of all cycles for the calculation of the ejection fraction, that are equal or equal to 80% of a maximum particular value. In addition a computer program was introduced for automatic compartment demarcation in equilibrium studies; the results were compared with conventional evaluations. The evaluation with automatic compartment limitation proved to be a simple, relatively user-independent technique for the determination of the ejection fraction on the basis of equilibrium studies. (orig.).

29388 **(INIS-mf—8388) Nuclear-medical method applied for determining the choledochus diameter after cholecystectomy.** Wolf, M. (Tuebingen Univ. (Germany, F.R.). Medizinische Fakultaet). 1980. 31p. (In German). NTIS (US Sales Only), PC A03/MF A01. Order Number DE84780197.

54 patients (46 of them females, 8 males) who underwent cholecystectomy were followed up roentgenologically by infusion cholangiography and nuclear-medicinally by quantitative hepatobiliary functional scintiscanning (HBFS). The ROI method applied for HBFS permits to record time/activity curves above the liver parenchyma (A) and the porta of the liver (B). By substracting curve A of curve B with the scale in which A is incorporated in B, a curve B' results, indicating the flow volume through the porta of the liver. The quotient Q=maximum pulse A to B/maximum pulse B to B indicates the portion of the liver parenchyma in the porta curve. The quotient represents a measure for the total volume of the large bile ducts included in the region of the porta of the liver. The quantity 1-Q/Q was put in relation with the roentgenologically determined common bile duct diameters. It resulted that both quantities correlated well, with a correlation coefficient of r=-0.860. Thus, the choledochus diameter can be determined in a primarily functional examination with a precision of 2 mm, a degree which permits the detection of clinically relevant discharge malfunctions. It was not possible to detect peristalsis-dependent phenomena with a dosage of 4-5 mCi 99 mTc-diethyl-IDA, an irradiation dose which was sufficient for answering the clinical questions and could be justified for the patients. (orig.).

29389 **(INIS-mf—8397) Spinocellular carcinoma of the lip, effects of radiotherapy. 109 case studies of the Dept. of Radiology of the Dermatological Clinic of Univ. Muenchen.** Hess, U. (Muenchen Univ. (Germany, F.R.). Fachbereich Medizin). 12 Jun 1979. 222p. (In German). NTIS (US Sales Only), PC A10/MF A01. Order Number DE84780199.

109 cases of spinocellular carcinoma of the lip were studied with a view to sex dependence, occupation, family disposition and colour of the skin, eyes and hair. Etiology, clinical aspects and course of lip carcinoma were studied. The results obtained with radiotherapy (X-ray therapy) are described and discussed. (APR).

29390 **(INIS-mf—8705) Universal multiprocessor system for the fast acquisition and processing of positron camera data.** Deluigi, B. (Heidelberg Univ. (Germany, F.R.). Naturwissenschaftlich-Mathematische Gesamtfakultaet). 1982. 141p. (In German). NTIS (US Sales Only), PC A07/MF A01. Order Number DE84780217.

In this study the main components of a suitable detection system were worked out, and their properties were examined. For the measurement of the three-dimensional distribution of radiopharmaka marked by positron emitters in animal-experimental studies first a positron camera was constructed. For the detection of the annihilation quanta serve two opposite lying position-sensitive gamma detectors which are derived in coincidence. Two commercial camera heads working according to the Anger principle were reconstructed for these purposes and switched together by a special interface to the positron camera. By this arrangement a spatial resolution of 0.8 cm FWHM for a line source in the symmetry plane and a coincidence resolution time 2T of 16ns FW0.1M was reached. For the three-dimensional image reconstruction with the data of a positron camera a maximum-likelihood procedure was developed and tested by a Monte Carlo procedure. In view of this application an at most flexible multi-microprocessor system was developed. A high computing capacity is reached owing to the fact that several partial problems are distributed to different processors and are processed parallely. The architecture was so scheduled that the system possesses a high error tolerance and that the computing capacity can be extended without a principal limit.

29391 (INIS-mf—8902, pp 1) **Diagnosis of osteoarthropathia psoriatica: comparison of clinical, radiological and scintigraphic data.** Petershofer, H.; Haydl, H.; Ellegast, H.H.; Prohaska, E. (Krankenhaus Kardinal Schwarzenberg, Schwarzach (Austria). Nuklearmedizinische Abt.). 1983. (In German). NTIS (US Sales Only), PC A05/MF A01. Order Number DE84780308. (CONF-8309215—Absts.). TI84780308

From Joint annual meeting of the Austrian Society for Internal Medicine, the Austrian Rheumatologic League and the Austrian Society for Nuclear M; Salzburg, Austria (22 Sep 1983).

Published in summary form only.

29392 **(ORNL/TM—9037) Nuclear medicine progress report for quarter ending December 31, 1983.** Knapp, F.F. Jr.; Ambrose, K.R.; Butler, T.A.; Goodman, M.M.; Srivastava, P.C. (Oak Ridge National Lab., TN (USA)). Apr 1984. Contract AC05-84OR21400. 23p. NTIS, PC A02/MF A01; GPO Dep. Order Number DE84012037.

In this report a multi-step synthesis of 19-iodo-3-(R,S)-methyl-18-nonadecenoic acid is described. In this new agent, the iodine is stabilized as a trans vinyliodide and the methyl group in position-3 was introduced to inhibit β-oxidation. The ^{125}I-labeled agent was evaluated in unfasted rats and showed essentially no loss from the myocardium over the initial 30 min period. Three new [^{125}I]-labeled iodopentenyl-substituted cation analogues have also been prepared and evaluated in rats to determine the relation between structure and relative heart and hepatobiliary uptake. The

triphenylarsonium and dihexylphenylphosphonium analogues showed tissue distribution properties very similar to the parent -triphenylphosphonium agent. The -dimethyl-n-octylphosphonium analogue, however, showed lower heart uptake and much greater hepatobiliary clearance. Carrier-free ^{103} ^{106}$RuCl_3$ by utilizing ruthenocenylmethyltrimethylammonium iodide as the key synthetic intermediate. The amino acid analog was evaluated as a pancreatic imaging agent but no selective uptake in the pancreas was observed. The High Flux Isotope Reactor (HFIR) resumed operation in January after replacement of the beryllium reflector shield. For the July-December 1983 period, several shipments of radiolabeled agents were made to Medical Cooperative investigators. 9 references, 3 figures, 4 tables.

29393 **(PB—84-154855) Study to determine the feasibility of computer diagnosis of the pneumoconioses. Final report.** Kruger, R.P. (University of Southern California, Los Angeles (USA). Electronic Sciences Div.). 1972. 90p. (USCEE—433). NTIS, PC A05/MF A01.

A study was undertaken to determine the feasibility for the possible automated mass diagnostic screening of pneumoconiosis radiographs. Two distinct textural feature extraction methods involving digital and coherent optical approaches were undertaken. The performance of the two automated diagnostic systems is described in detail in tables presented in the main body of this report. Analagous results are presented for diagnosis obtained from experienced radiologists asked to analyze the same films given to the automated systems.

29394 **(PB—84-155084) Chest x-ray analysis by computer. Final report.** (National Biomedical Research Foundation, Washington, DC (USA)). 15 Sep 1972. 12p. NTIS, PC A02/MF A01.

See also PB84-155092.

This report describes a study program which was concerned with the investigation of chest x-rays containing various classifications of pneumoconiosis. Samples of x-rays were digitized using a programmable light source (a computer-controlled CRT scanner). The digitized data were then processes in various ways and subsequently applied to the CRT scanner system to generate photographic images. The purpose of the transformations was to (1) determine the basic characteristics of typical chest x-rays with regard to resolution and gray scale content, (2) present the data in a manner which accentuates or facilitates the classification of pneumoconiosis, (3) determine the necessary hardware and specify its operating characteristics for ultimate use as a computer input system (digitization system). The results of these investigations are included in this report, along with the images recorded during this study.

29395 **(PB—84-155092) Chest x-ray analysis by computer: final technical report.** (National Biomedical Research Foundation, Washington, DC (USA)). 1972. 122p. NTIS, PC A06/MF A01.

See also PB84-155084.

The purpose of this study was to evaluate and demonstrate the feasibility of the automated analysis of chest x-rays for the classification of pneumoconiosis films according to the U.I.C.C./Cincinnati standard films. Toward this end, computer programs simulating the proposed systems were prepared. Using these programs, the authors then examined three sets of chest radiographs to determine the extent of pneumoconiosis present. The results of the examinations of these x-rays clearly indicated the feasibility of the proposed system. Based on the outcome of these examinations, a complete set of hardware and software specifications were established for a system which can be used for the large scale automatic analysis of chest x-rays.

29396 **Evaluation of synchrotron x-rays for digital subtraction coronary angiography.** Otis, J.N.; Campbell Finman, L.; Hofstadter, R.; Hudson, A.; Hughes, E.B.; Rolfe, J.; Rubenstein, E.; Zeman, H.D. (Hansen Laboratories of Physics and Dept. of Physics, Stanford Univ., Stanford, CA 94305). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Nuclear Science;* **31**: No. 1, 581-584(Feb 1984). (CONF-831015—).

From Nuclear science symposium; San Francisco, CA, USA (19 Oct 1983).

The intensity and tunability of synchrotron X-ray beams are highly suited to the non-invasive detection of iodine by K-edge digital subtraction angiography. An imaging system developed for in vivo canine studies is described. Considerations relating to an expanded system for human subject studies are discussed.

29397 **In vivo comparison of 16α-[^{77}Br]bromoestradiol-17β and 16α-[^{125}I]Iodoestradiol-17β.** McElvany, K.D.; Carlson, K.E.; Welch, M.J.; Senderoff, S.G.; Katzenellenbogen, J.A. (Washington Univ. School of Medicine, St. Louis, MO). *Journal of Nuclear Medicine;* **23**: No. 5, 420-424(May 1982). Contract AC02-81EV10650.

An in vivo comparison of two estrogen-receptor-binding radiopharmaceuticals of high specific activity, 16α-[^{77}Br]bromoestradiol-17β and 16α-[^{125}I]iodoestradiol-17β, has been carried out in immature female rats. The iodoestradiol has slightly higher uterine uptake at 1 hr after injection, whereas the brominated analog has significantly enhanced uptake at later times. The similar behavior of the two compounds in vivo suggests that estradiol labeled with I-123, Br-77, or Br-75 could be used interchangeably for the imaging of breast tumors containing estrogen receptors. In addition, coinjection of 16α-[^{125}I]iodoestradiol as an internal standard has been shown to be useful for comparison of different radiohalogenated estrogens. 17 references, 4 tables, 1 figure.

29398 **Localization and therapeutic potential of tritiated tetracycline in rodent tumors.** Davis, R.C.; Wood, P.; Mendelsohn, M.L. (Lawrence Livermore Lab., CA). *Cancer Research;* **37**: 4539-4545(Dec 1977). Contract W-7405-ENG-48.

The reputed localization of tetracycline in human and animal tumors suggested that chemically stable, high-specific-activity tritiated tetracycline (TTC) might have antineoplastic therapeutic potential. Direct therapeutic effects were tested in two transplanted tumor lines in rats, and the localizing properties of TTC were measured in 30 transplanted tumor lines in rats and mice and in 23 spontaneous mammary tumors in rats. The therapeutic studies demonstrated that, while a significant reduction in the growth rates of transplanted tumors could be obtained through the administration of heavy doses of TTC, similar reductions were observed in the growth rates of tumors in animals receiving unlabeled tetracycline. In the localization studies the concentrations of TTC in normal tissues and tumors were compared and correlated with corresponding concentrations of [^{14}C]-thymidine, a measure of proliferative activity. Significantly greater binding of TTC over normal tissue occurred only in areas that failed to incorporate [^{14}C]thymidine. Rapidly proliferating areas of tumors, as measured by [^{14}C]thymidine incorporation, bound tetracycline in concentrations similar to muscle and significantly lower than kidney. The lack of localization in viable tumor and the absence of a tritium effect in treated tumors argues strongly against the therapeutic value of TTC at least to the extent that the results on this broad spectrum of tumors can be generalized.

5507 Microbiology

REFER ALSO TO CITATION(S) 28084, 28085, 28086, 29293, 29380, 29413, 29465

29399 (ANL—83-100-Pt.2, pp 70-76) **Growth inhibitor of E. coli K-12 in a sample of ^{39}KCl.** Luckey, T.D. Mar 1984. NTIS, PC A09/MF A01. Order Number DE84008870. TI84008870

In Environmental Research Division annual report: Center for Human Radiobiology, July 1982-June 1983.

Growth rates and total population of E. coli were reduced fourfold when natural KCl (/sup N/KCl) in the medium was replaced by ^{39}KCl from a particular source. A prolonged lag period was noted in cultures containing either /sup N/KCl or ^{39}KCl when inoculated with bacteria adapted to ^{39}KCl. These changes were not due to endogenous radiation because these differences were not observed when (a) the KCl concentrations were reduced from 50 to 5 mM and (b) the ^{39}KCl from the prime source was replaced with ^{39}KCl from a second source; also the addition of ^{40}KCl to ^{39}KCl

did not improve growth. These results suggest that the ^{39}KCl from the primary source contained an unidentified inhibitor that is not readily detected by physical and chemical analyses. 8 references, 3 figures, 2 tables.

29400 (NP—4770275) **Reactional studies on the formation of protein from cellulose waste.** Hecht, V. (Hannover Univ. (Germany, F.R.). Fakultaet fuer Mathematik und Naturwissenschaften). 17 Feb 1982. 95p. (In German). NTIS (US Sales Only), PC A05/MF A01. Order Number DE84770275.

Portions are illegible in microfiche products.

The aim of these studies was to work out a design of reactors for converting cellulose to protein-containing animal feed. The microorganism Chaetomium cellulolytikum (ATCC 32319) was used for this purpose. The growth behaviour of this microorganism was studied in a 20 l batch reactor on the substrates glucose, avicel (pure crystalline cellulose) and presteam-treated and ammonia-treated straw. The influence of the operating parameter, stirrer rotation rate, on growth behaviour was also studied on avicel-cellulose. Here it was shown that productivity could be increased by reducing rotation speed and increasing the substrate concentration. The growth parameters established from these studies will be used in setting up a kinetic model and in the design of a reactor.

29401 (ORNL—6021, pp 81-83) **Microbial mutagenesis and cell division.** Adler, H.I.; Crow, W.D.;; Machanoff, R.; Sozer, A. Jan 1984. NTIS, PC A12/MF A01. Order Number DE84006248. TI84006248

In Biology Division. Progress report, August 1, 1982-September 30, 1983.

New methods for cultivating anaerobic bacteria were developed on the use of a sterile membrane fraction from Escherichia coli. The fraction efficiently reduces oxygen to water over a broad range of temperature and pH in both liquid and solid media. Twenty anaerobes representing ten genera have been grown in liquid media containing the membrane fraction. If bacteria and the fraction are incorporated into pour plates overlayed with a thin layer of agar, colonies develop without the use of anaerobic containers.

29402 **Adaptation of the cyanobacterium Microcystis aeruginosa to light intensity.** Raps, S.; Wyman, K.; Siegelman, H.W.; Falkowski, P.G. (Brookhaven National Lab., Upton, NY). *Plant Physiology;* 72: 829-832(1983). Contract AC02-76CH00016.

Light intensity adaptation (20 to 565 microeinsteins per square meter per second) of Microcystis aeruginosa (UV-027) was examined in turbidostat culture. Chlorophyll a and phycocyanin concentrations decreased with increasing light intensity while carotenoid, cellular carbon, and nitrogen contents did not vary. Variation in the number but not the size of photosynthetic units per cell, based on chlorophyll a/P_{700} ratios, occurred on light intensity adaptation. Changes in the numbers of photosynthetic units partially dampened the effects of changes in light intensity on growth rates.

5508 Morphology

REFER ALSO TO CITATION(S) 29306, 29336, 29471

29403 (ORNL—6021, pp 127-129) **Analysis of spontaneous early embryonic lethality in mice.** Larsen, M.M.; Generoso, W.M. Jan 1984. NTIS, PC A12/MF A01. Order Number DE84006248. TI84006248

In Biology Division. Progress report, August 1, 1982-September 30, 1983.

From controls of dominant-lethal experiments conducted in the laboratory over many years, it is clear that the normal incidence of deciduomata in uteri of pregnant females varies considerably with the strain of the female. The objective of the embryo-transfer study was to compare the incidence of deciduomata when normal-appearing 2- to 8-cell embryos are transferred from females of each of the two strains to females of either the same or the other strain. We found a higher incidence of deciduomata (1.5 to 2) when the donor strain was the T-stock regardless of the strain of recipient.

29404 (ORNL—6021, pp 129-130) **Establishment of an embryo-freezing program for the preservation of genetic stocks.** Russell, L.B.; Larsen, M.M. Jan 1984. NTIS, PC A12/MF A01. Order Number DE84006248. TI84006248

In Biology Division. Progress report, August 1, 1982-September 30, 1983.

During the past year, the embryo freezing laboratory has been fully operative, equipment and original technique problems have been solved. For each stock, freezing-success trials are performed in which a sample of frozen embryos is thawed, implanted into pseudopregnant host females, and raised to birth. A stock is not discarded unless the trial is successful.

29405 (ORNL—6021, pp 159-163) **Regulation of gene expression.** Kenney, F.T.; Lee, K.L.; Isham, K.R.; Holloway, G.R.; Stringfellow, L.A.; Balogh, L.A.; Johnson, A.C.; Rothrock, R.S.; Tindal, M.H. Jan 1984. NTIS, PC A12/MF A01. Order Number DE84006248. TI84006248

In Biology Division. Progress report, August 1, 1982-September 30, 1983.

In order to define in molecular terms the mechanisms controlling expression of specific genes in mammalian cells, how gene expression is activated, how tissue-specific expression is effected, how expression is modulated by hormones and other specific effectors, and how genetic control mechanisms are altered in the dysfunction of gene expression in cells transformed to malignancy were studied. Much of this work has focused on expression of the rat liver enzyme tyrosine aminotransferase.

5509 Pathology

REFER ALSO TO CITATION(S) 29369, 29403

29406 **(AD-A—137010/5) Cryomicrotome applications: techniques for the study of skeletal materials. Technical report.** Smith, K.C.; Oloff, C.M.; Kazarian, L.E. (Aerospace Medical Research Lab. (6570th), Wright-Patterson AFB, OH (USA)). Sep 1983. 20p. NTIS, PC A02/MF A01.

The LKB 2250 PMV Cryomicrotome is a large sledge-type microtome designed for sectioning both undecalcified bone and specimens of large size. The maximum specimen size is 150 x 450 mm, sufficient for an entire rabbit or small monkey.

29407 **(INIS-mf—8383) Quantitative autoradiography of ^{14}C-D-glucose metabolism of normal and traumatized rat brain using micro-absorption photometry.** Bonorden, S. (Giessen Univ. (Germany, F.R.). Fachbereich Humanmedizin). 1980. 200p. (In German). NTIS (US Sales Only), PC A09/MF A01. Order Number DE84780189.

It could be shown using ^{14}C-glucose as energy-providing substrate for brain tissue metabolism that for bolus type application a retarded and even channelling of the substrate into the metabolic process takes place. The presence of tracer in the tissue was established using autoradiography. A linear correlation between the amount of tissue-incorporated ^{14}C section thickness and exposure time could be established by means of densitometric measurement of brain sections of various thicknesses, by applying various ^{14}C-activities and by different exposure times. From these correlations direct conclusions may be made regarding the specific activity of the tissue provided that exposure time and section thickness of the sample are known. Comparative studies between cortex and deeper structures and between traumatized and non-traumatized brain tissue show that the rate of metabolism in brain cortex is markedly higher than in underlying structures and that ^{14}C-incorporation is higher in traumatized tissue than in non-traumatized tissue. Whilst the difference in rate of metabolism between brain cortex and deep structures can be clearly related to the differing cell count/unit surface area for cortex and the deeper structures, the different energy conversion rates for functionally damaged and normal brain tissue is a specific characteristic of injury. Apart from the fact that an increased ^{14}C-deposition is in no way indicative of an increased metabolic activity, the possibility of quantifying ^{14}C-tissue content provides a basis for estimating therapeutic effects e.g. in the treatment of trauma-caused brain edema. (orig.).

29408 **(LA-UR—84-1245) Kinetics of red blood cell aggregation: an example of geometric polymerization.** Perelson, A.S.; Samsel, R.W. (Los Alamos National Lab., NM (USA); Brown Univ., Providence, RI (USA). Div. of Biology and Medicine). 2 Apr 1984. Contract W-7405-ENG-36. 9p. (CONF-8404141—1). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE84011370.

From International topical conference on kinetics of aggregation and gelation; Atlanta, GA, USA (2 Apr 1984).

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The kinetics of the process by which red blood cells aggregate into long cylindrical, and sometimes branched, structures called rouleaux is studied within the framework of both reversible and irreversible addition and condensation polymerization reactions. However, unlike usual polymer kinetics, here we take into account the geometry of the subunits and the geometry of the growing structure. Geometric factors such as the amount of reactive wall area influence the probability of branching and hence the final shape of the aggregate. The inclusion of loop formation reactions is shown to be crucial in obtaining physically realistic equilibrium solutions of the kinetic equations. 11 references, 3 figures.

29409 (ORNL—6021, pp 163-167) **Tumor cell surface proteins.** Kennel, S.J.; Braslawsky, G.R.; Flynn, K.; Foote, L.J.; Hotchkiss, J.A.; Huang, A.H.L.; Lankford, P.K. Jan 1984. NTIS, PC A12/MF A01. Order Number DE84006248. TI84006248

In Biology Division. Progress report, August 1, 1982-September 30, 1983.

A tumor surface protein of 180,000 M/sub r/ (TSP-180) has been identified on cells of several lung carcinomas of BALB/c mice. TSP-180 was not detected on normal lung tissue, embryonic tissue, or other epithelial or sarcoma tumors, but it was found on lung carcinomas of other strains of mice. Considerable amino acid sequence homology exists among TSP-180s from several cell sources, indicating that TSP-180 synthesis is directed by normal cellular genes although it is not expressed in normal cells. The regulation of synthesis of TSP-180 and its relationship to normal cell surface proteins are being studied.

29410 **Monoclonal antibodies in cancer detection and therapy.** Kennel, S.J.; Flynn, K.; Foote, L.; Lankford, T. (Oak Ridge National Lab., TN). *BioScience;* **34**: No. 3, 150-156(Mar 1984). Contract W-7405-ENG-26.

The advent of monoclonal antibodies has revolutionized thinking about cancer therapy management. In this article, the authors review some of the applications of monoclonal antibodies in cancer research and identify requirements for monoclonal antibody to be useful in cancer detection or therapy. Empirical tests of antibody circulation in vivo are necessary to establish specificity. 68 references, 3 figures.

29411 **Adult-onset nemaline rods in a patient treated for suspected dermatomyositis: study with two-dimensional electrophoresis.** Danon, M.J.; Giometti, C.S.; Manaligod, J.R.; Perurena, O.H.; Skosey, J.L. (Univ. of Illinois, Chicago). *Archives of Neurology;* **38**: 761-766(Dec 1981). Contract W-31-109-ENG-38.

A 65-year-old woman with progressive muscle weakness and a diffuse rash of three years' duration was examined. Muscle tissue was studied with histochemical techniques, phase-contrast microscopy, electron microscopy, and two-dimensional electrophoresis. Histochemical studies showed numerous nemaline rods, with a normal ratio of types I and II fibers. Two-dimensional electrophoresis revealed abnormalities in the myosin light chain and tropomyosin protein patterns when compared with normal and diseased muscle biopsy samples, including those from two patients with adult-onset dermatomyositis.

5510 Physiological Systems

REFER ALSO TO CITATION(S) 29359

29412 **(DOE/EV/70022—13-1) Hydrogel modified materials surfaces for the ERDA artificial heart. Final report .** Hoffman, A.S. (Washington Univ., Seattle (USA). Dept. of Chemical Engineering). 14 Sep 1978. Contract AT06-76EV70022. 108p. NTIS, PC A06/MF A01; 1; GPO Dep. Order Number DE84002119.

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This report summarizes a series of studies on the suitability of silicone surgical grafts. The studies performed include an evaluation of vena cava rings to study thrombogenicity of grafted polymer coatings, the interaction of platelets with radiation grafted polymers, an in vitro evaluation of knitted dacron artery sections, the tissue compatibility of HEMA-EMA copolymers, the in vitro cell adhesion to polymeric materials, and the use of the ESCA technique for determining HEMA/EMA ratios.

29413 **Effect of food acclimation on assimilation efficiency of Calanus pacificus.** Landry, M.R.; Hassett, R.P.; Fagerness, V.; Downs, J.; Lorenzen, C.J. (Univ. of Washington, Seattle). *Limnology and Oceanography;* **29**: No. 2, 361-364(Mar 1984). Contract AT06-76EV75026.

A technique, based on quantitative conversion of chlorophyll a to pheophorbide during digestion, is described for determination of assimilation efficiencies of particle-feeding zooplankton. Calanus pacificus had assimilation efficiencies ranging from 68.5 to 85.4% for carbon and 73.9 to 92.5% for nitrogen. Assimilation efficiencies for copepods first acclimated to different food concentrations of Thalassiosira weissflogii and then fed at the same food level varied systematically, with animals acclimated to low food having higher efficiencies than animals acclimated to high food.

29414 **Narrow-spectrum chemoreceptor cells in the walking legs of the lobster Homarus americanus: taste specialists.** Derby, C.D.; Atema, J. (Marine Biological Lab., Woods Hole, MA). *Journal of Comparative Physiology;* **146**: 181-189(1982). Contract AC02-76EV02546.

The chemoreceptors in the legs of lobsters function in the localization and handling of food. By single-unit extracellular recording techniques, the specificity of single primary chemoreceptor cells is described here in detail. In contrast to what is known in vertebrates, narrow-spectrum chemoreceptors of several different types were found, each type responding with maximal sensitivity to only one of the following compounds: L-glutamate, L-glutamine, L-arginine, taurine, betaine, and ammonium chloride. Ammonium chloride sensitive cells were also highly specific. Other groups of narrow-spectrum cells - L-arginine, L-glutamine, taurine, and betaine sensitive chemoreceptors - showed equally strong specificity. These results indicate that the peripheral coding system in the legs of lobsters is based largely but perhaps not exclusively on narrow-spectrum chemoreceptor cells.

29415 **Chemosensitivity of walking legs of the lobster Homarus americanus: neurophysiological response spectrum and thresholds.** Derby, C.D.; Atema, J. (Marine Biological Lab., Woods Hole, MA). *Journal of Experimental Biology;* **98**: 303-315(1982). Contract AC02-76EV02546.

Responses of chemoreceptors in the walking legs of the lobster Homarus americanus to 35 individual compounds and 3 mixtures (prey odours and extracts) were studied using extracellular recording techniques. Compared against a standard mussel (Mytilus edulis) extract, these receptors were most sensitive to the amino acids L-glutamate, hydroxy-L-proline, L-aspartate, L-arginine, glycine, taurine, and L-alanine, as well as such other compounds as ammonium chloride, betaine, and the tripeptide glutathione. Most of these excitants are among those compounds most prevalent in the prey of lobsters.

5520 Public Health

REFER ALSO TO CITATION(S) 29309

29416 (UCRL—15591) Malignant melanoma in the Kaiser Foundation health plan of northern California: a comparison of incidence and measures of health care utilization between the Lawrence Livermore National Laboratory and surrounding health plan groups. Hiatt, R.A.; Fireman, B. (Kaiser Foundation Research Inst., Oakland, CA (USA). Dept. of Medical Methods Research). Feb 1984. Contract W-7405-ENG-48. 44p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE84011050.

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We investigated the hypothesis that the increased incidence of malignant melanoma at Lawrence Livermore National Laboratory (LLNL) was due to a difference in the medical care received by LLNL employees compared to nonLLNL residents of the same geographic area. Utilizing records of the Kaiser Foundation Health Plan (KFHP) to which about half of the LLNL employees belong, we confirmed that the incidence of melanoma at LLNL was about three times that in the surrounding community (62.4/100,000 vs 20.9/100,000 in the members served by the Walnut Creek KFHP facility, $p = 0.040$. Furthermore, rates of biopsy for junctional, compound and dermal nevi were also higher among LLNL employees than the Walnut Creek membership. The melanoma rate among LLNL spouses was close to that of the employees themselves, but was based on only six cases. Rates among employees of the University of California at Davis, a group likely to be similar to LLNL employees in academic background and sun exposure, were not elevated compared to overall KFHP rates. In a comparison between LLNL employees without melanoma and comparable controls in the Walnut Creek membership, there was no clear difference in the number of visits for skin problems. However, LLNL employees had substantially more skin biopsies than the controls. After 1976 when the excess of melanoma at LLNL first received publicity, the difference in the mean number of biopsies was significantly greater ($p = 0.048$). We conclude that the sustained increase in melanoma incidence at LLNL is associated with an increased likelihood of being biopsied for pigmented skin lesions. This association may be because physicians caring for LLNL employees are more concerned about the potential malignancy of pigmented lesions.

5530 Agriculture And Food Technology

REFER ALSO TO CITATION(S) 28513, 29253, 29265, 29320, 29506, 29507

29417 (TVA/ONRED/AWR—84/8) Evaluation of liquid oxygen to increase channel catfish production in heated water raceways. Collins, C.M.; Burton, G.L.; Schweinforth, R.L. (Tennessee Valley Authority, Knoxville (USA). Div. of Air and Water Resources). Mar 1984. 23p. NTIS, PC A02/MF A01. Order Number DE84901134.

Liquid oxygen (LOX) was used to maintain dissolved oxygen (DO) levels in the highest of two stocking densities to evaluate its economic feasibility and impact on production. Six 17.4 m^3 (614 ft^3) concrete raceways were stocked with 15 to 18 cm (6 to 7 in.) channel catfish at 141 and 282 fish/m^3 (4 and 8 fish/ft^3). LOX was used when fish biomass reached 48 kg/m^3 (3 lb/ft^3). Gross production, average weight and survival were significantly enhanced in the LOX raceways. Food conversion was similar in all raceways for the 154-day study. LOX increased production cost $0.03/lb of fish, but production in LOX raceways averaged 307 percent greater than in raceways without LOX. The use of LOX would reduce capital outlay for construction of an aquaculture facility. 5 references, 4 figures, 5 tables.

56 BIOMEDICAL SCIENCES, APPLIED STUDIES

5601 Radiation Effects

REFER ALSO TO CITATION(S) 29343, 29441

29418 (ANL—83-100-Pt.2) Environmental Research Division annual report: Center for Human Radiobiology, July 1982-June 1983. (Argonne National Lab., IL (USA)). Mar 1984. Contract W-31-109-ENG-38. 180p. NTIS, PC A09/MF A01; GPO Dep. Order Number DE84008870.

This is the fourteenth Annual Report of the Center for Human Radiobiology. New cases of bone cancer and carcinoma of head sinuses are occurring at a rate of about one per year in patients who acquired radium burdens 50 to 60 years ago. Several papers deal with dosimetry of alpha-emitting radionuclides in man, in animals, or in the environment. The report concludes with an appendix containing data on the exposure of 2312 persons whose radium content has been determined and an appendix listing the classical radium-related malignancies (osteosarcomas and carcinomas of the paranasal sinuses and mastoid).

29419 (ANL—83-100-Pt.2, pp 1-3) Recent cases of radium-induced malignancy. Adams, E.E. Mar 1984. NTIS, PC A09/MF A01. Order Number DE84008870. TI84008870

In Environmental Research Division annual report: Center for Human Radiobiology, July 1982-June 1983.

Three cases of malignant disease attributed to radium in patients with measured body burdens have been observed since 1978 - one paranasal sinus carcinoma, one mastoid carcinoma, and one fibrosarcoma of bone. These cases are summarized here. 4 references.

29420 (ANL—83-100-Pt.2, pp 4) Age and dose as determinants of times of appearance of radium-induced osteosarcomas in humans. Stebbings, J.H.; Lucas, H.F. Mar 1984. NTIS, PC A09/MF A01. Order Number DE84008870. TI84008870

In Environmental Research Division annual report: Center for Human Radiobiology, July 1982-June 1983.

Determinants of time-until-tumor for bone sarcomas in US radium cases have been reevaluated. For the 57 measured female bone sarcoma cases exposed to ^{226}Ra and/or ^{228}Ra, ages at appearance of tumor are more strongly correlated with radium intake doses than are latency periods.

29421 (ANL—83-100-Pt.2, pp 5) Multiple myeloma, leukemia, and breast cancer among the US radium dial workers. Stebbings, J.H.; Lucas, H.F.; Stehney, A.F. Mar 1984. NTIS, PC A09/MF A01. Order Number DE84008870. TI84008870

In Environmental Research Division annual report: Center for Human Radiobiology, July 1982-June 1983.

The relationships of radium exposure to mortality from multiple myeloma, leukemia, and breast cancer were studied in three cohorts of female dial workers defined by year of first employment. A three-fold excess risk of multiple myeloma occurred in the pre-1930 cohort; however, analyses of body burdens and durations of employment suggest that external radiation was more likely to have been responsible than was internal radium. Leukemia incidence and mortality have not been elevated overall among the female dial workers, either in the pre-1930 or the post-1930 cohorts, but cases have tended to occur early and in subjects with higher body burdens of radium. Extensive analyses of breast cancer data have uncovered several observations weighing against a causal interpretation of the association between radium body burdens and breast cancer.

29422 (ANL—83-100-Pt.2, pp 6) Risks of cancers of selected sites among female radium dial workers. Stebbings, J.H.; Lucas, H.F.; Stehney, A.F. Mar 1984. NTIS, PC A09/MF A01. Order Number DE84008870. TI84008870

In Environmental Research Division annual report: Center for Human Radiobiology, July 1982-June 1983.

The 1285 identified, located radium dial painters employed before 1930 have now experienced significant mortality from cancers of sites other than those (bone and head) known to be radium induced. We analyze the relationships of radium exposure to fatal cancers of common soft-tissue sites: stomach, colon, rectum, liver, pancreas, lung, breast, cervix, and corpus uteri. Incident multiple myeloma, leukemia, and breast cancer were also studied.

29423 (ANL—83-100-Pt.2, pp 7-13) **Non-stochastic effects of ^{226}Ra and ^{228}Ra in the human skeleton.** Keane, A.T.; Kirsh, I.E.; Lucas, H.F.; Schlenker, R.A.; Stehney, A.F. Mar 1984. NTIS, PC A09/MF A01. Order Number DE84008870. TI84008870

In Environmental Research Division annual report: Center for Human Radiobiology, July 1982-June 1983.

Non-cancerous skeletal lesions are observed radiographically in humans carrying internal deposits of ^{226}Ra and ^{228}Ra and in beagles following injection of ^{226}Ra, ^{228}Ra, or ^{239}Pu. These radiographic changes are therefore particularly relevant to the assessment of the health effects of intakes of plutonium and other bone-seeking radionuclides released to the environment by the nuclear industry and by fossil-fuel and nuclear power plants. In this paper, results are reported of a comparative evaluation of the non-malignant changes that have been observed radiographically in the bones of two groups of former radium dial workers, all female - one group exposed predominantly to ^{226}Ra and the other predominantly to ^{228}Ra.

29424 (ANL—83-100-Pt.2, pp 14) **Morphology of cells malignantly transformed by alpha particle irradiation.** Lloyd, E.L.; Henning, C.B. Mar 1984. NTIS, PC A09/MF A01. Order Number DE84008870. TI84008870

In Environmental Research Division annual report: Center for Human Radiobiology, July 1982-June 1983.

In experiments where mouse embryo cells were irradiated with a parallel beam of 5.6 MeV alpha particles from a Tandem Van de Graaff machine, we noted that about 10 to 20 alpha particles through each nucleus were required to kill 2/3 of the cells. Earlier workers failed to make measurements of nuclear areas of the cells as they were irradiated.

29425 (ANL—83-100-Pt.2, pp 15-20) **Unusual case of radium exposure.** Toohey, R.E.; Sha, J.Y.; Urnezis, P.W.; Hwang, E.Y. Mar 1984. NTIS, PC A09/MF A01. Order Number DE84008870. TI84008870

In Environmental Research Division annual report: Center for Human Radiobiology, July 1982-June 1983.

We have determined the body content, distribution, retention, and excretion rate of ^{226}Ra for a uranium mill worker who inhaled ^{226}Ra in an unknown form. Radium was retained in the lung with a biological half-life of 120 days, an the amount initially inhaled was estimated to be 180 +- 30 Bq. These values, combined with an observed radon retention factor of 71%, implied a 50-year dose commitment of 0.16 +- 0.04 Sv to the lung. Although it is believed that this case represents an isolated incident, it is possible that some uranium mill workers may form a contemporary population that is occupationally exposed to radium. 5 references, 2 figures, 2 tables.

29426 (ANL—83-100-Pt.2, pp 21-32) **Relative activities of ^{212}Bi (thorium-C) and ^{228}Ra (mesothorium-1) in former radium dial workers.** Keane, A.T.; Essling, M.A.; Lucas, H.F. Mar 1984. NTIS, PC A09/MF A01. Order Number DE84008870. TI84008870

In Environmental Research Division annual report: Center for Human Radiobiology, July 1982-June 1983.

From analyses of bones, estimates were made of the relative intakes of ^{228}Ra and ^{226}Ra by the employees of a dial-painting studio that used luminous compounds activated with technical mesothorium. These data, in turn, were used to derive estimates of ^{228}Ra activity from activities of ^{226}Ra in living colleagues whose body contents of ^{226}Ra and ^{212}Bi had been measured. The indirectly determined ^{212}Bi to ^{228}Ra activity ratios in the living workers averaged 1.56 +- 0.10 (S.E.) at a median of 42 yr post intake. If no ^{228}Ra decay products are excreted, the expected ^{212}Bi to ^{228}Ra activity ratio at 42 yr after intake is 1.59 according to the simple power function of radium retention of Norris et al., and 1.72 according to the alkaline earth model of ICRP No. 20. 15 references, 2 tables.

29427 (ANL—83-100-Pt.2, pp 51-60) **Gastrointestinal absorption and retention of plutonium and uranium in the baboon.** Larsen, R.P.; Bhattacharyya, M.H.; Oldham, R.D.; Moretti, E.S.; Cohen, N. Mar 1984. NTIS, PC A09/MF A01. Order Number DE84008870. TI84008870

In Environmental Research Division annual report: Center for Human Radiobiology, July 1982-June 1983.

Individual isotopes of plutonium and uranium were administered both intragastrically and intravenously to a baboon. Samples of urine, faces, blood, and tissues were taken and are now being analyzed. Preliminary results indicate that the fractional absorptions of plutonium and uranium were 1×10^{-3} and 1×10^{-2}, respectively, and their retentions about one month later were about 20% and 10%, respectively, of the amounts absorbed. The fractional retentions of the intravenously injected plutonium and uranium at that time were 0.90 and 0.07. 13 references, 1 figure, 3 tables.

29428 (ANL—83-100-Pt.2, pp 61-64) **Radiochemical method for the simultaneous determination of ^{233}U, ^{236}U, ^{237}Np, ^{236}Pu, ^{238}Pu, and ^{239}Pu in biological materials.** Oldham, R.D.; Larsen, R.P. Mar 1984. NTIS, PC A09/MF A01. Order Number DE84008870. TI84008870

In Environmental Research Division annual report: Center for Human Radiobiology, July 1982-June 1983.

A radiochemical method has been developed for the determination of multiple isotopes of uranium, neptunium, and plutonium in biological materials. The elements are separated from the other sample constituents and from each other by anion exchange in halide media. Their recoveries are monitored by isotopic diluents. The amounts of the analyte and diluent isotopes of each element are measured alpha spectrometrically. The interelemental separation factors are generally greater than 10^2, and the recovery of each element ranges from 60% to 90%. 4 references, 1 table.

29429 (ANL—83-100-Pt.2, pp 65-68) **Gastrointestinal absorption and distribution of thorium in the mouse.** Larsen, R.P.; Oldham, R.D.; Bhattacharyya, M.H.; Moretti, E.S. Mar 1984. NTIS, PC A09/MF A01. Order Number DE84008870. TI84008870

In Environmental Research Division annual report: Center for Human Radiobiology, July 1982-June 1983.

The retention of thorium in liver, bone, and other tissues subsequent to its gastrointestinal absorption has been determined in fasted mice. The value obtained for fractional retention was 1.0×10^{-3}, which is about a factor of two lower than the values for plutonium and neptunium. The tissue distribution and the value for fractional excretion of absorbed thorium were the same as those for intravenously injected thorium. 5 references, 1 table.

29430 **(BNL—34757) Risk evaluation - conventional and low level effects of radiation.** Bond, V.P.; Varma, M.N. (Brookhaven National Lab., Upton, NY (USA)). Apr 1984. Contract AC02-76CH00016. 10p. (CONF-8404149—1). NTIS, PC A02; 3; GPO Dep. Order Number DE84011846.

From International symposium on environmental pollution and man; Cape Town, South Africa (30 Apr 1984).

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Any discussion of the risk of exposure to potentially-hazardous agents in the environment inevitably involves the question of whether the dose effect curve is of the threshold or linear, non-threshold type. A principal objective of this presentation is to show that the function is actually two separate relationships, each representing distinctly different functions with differing variables on the axes, and each characteristic of quite different functions with differing variables on the axes, and each characteristic of quite different disciplines (i.e., the threshold function, of Pharmacology, Toxicology and Medicine [PTM]; the linear, non-threshold function, of Public Health including safety and accident statistics [PHS]). It is shown that low-level exposure (LLE) to radiation falls clearly in the PHS category. A function for cell dose vs. the fraction of single cell quantal responses is characterized, which reflects the absolute and relative sensitivities of cells. Acceptance of this function

would obviate any requirement for the use in Radiation Protection of the concepts of a standard radiation, Q, dose equivalent and rem. 9 references, 4 figures.

29431 **(CONF-830665—6) Analytical methods for radionuclides in liquid and solid media.** Sedlet, J. (Argonne National Lab., IL (USA)). 1983. Contract W-31-109-ENG-38. 29p. NTIS, PC A03/MF A01; GPO Dep. Order Number DE84010522.

From Health Physics Society summmer school on internal radiation dosimetry; Catonsville, MD, USA (12 Jun 1983).

This lecture describes in vitro techniques for the radiochemical determination and dosimetry of radionuclides in the body that have been metabolized and are in the circulatory system. Measurements are made in the excretions and other body specimens such as blood, perspiration, hair, exhaled air, and tissue. 13 references, 4 tables. (ACR)

29432 **(INIS-BR—100) Uptake by benthic algae of critical radionuclides to be released in the liquid effluent of the Angra dos Reis Nuclear Power Plant, R.J., Brazil.** Guimaraes, J.R.D. (Rio de Janeiro Univ. (Brazil). Inst. de Biofisica). Jun 1982. 132p. (In Portuguese). NTIS (US Sales Only), PC A07/MF A01. Order Number DE84780188.

In vitro interaction of benthic algae from the Angra dos Reis region, R.J., Brazil, was studied with critical radionuclides to be released in the liquid effluent of CNAAA (unit I). ^{137}Cs-^{60}Co - and ^{125}I uptake and loss by Sargassum filipendula, Padina Vickersiae and Acanthophora Spicifera were observed. Biological half-lives and bioaccumulation factors (B.F.) were estimated. Co and I uptake were fast (apparent equilibrium in 3 to 7 days). Cs uptake was slower (2 to 3 weeks). Loss followed an inverse pattern (fast for Cs, slow for Co and I). B.F. ranged from 10^1 for Cs, to 10^3 for I and 10^3-10^4 for Co. Higher B.F. for Co and I were found for P. vickersiae (up to 1,4 X 10^4) an A. spicifera (up to 7 X 10^3) respectively. These species represent important potential media for the transference of Co-I-and-to a much lesser extent - Cs isotopes, through food-webs. They exhibited high capacity to compete with local sandy sediments for the retention of Co and I. High B.F., rapid uptake and moderate to long biological half-lives enable S. filipendula, P. vickersiae and A. specifera to be powerful aids in the monitoring of radioactive contamination by Co and I isotopes. Since the majority of marine organisms tends to exhibit Cs B.F. similars to those reported here, these algae may also be used as monitors for Cs isotopes, the low B.F. being compensated by their abundance, wide distribution and facility of collection. (M.A.).

29433 **(INIS-mf—8381) Measurements and considerations concerning the application of X-rays under particular consideration of the X-radiation regulations.** Ewen, K. (Technische Hochschule Aachen (Germany, F.R.). Medizinische Fakultaet). 2 Nov 1981. 136p. (In German). NTIS (US Sales Only), PC A07/MF A01. Order Number DE84780193.

The obtained results - concerning particularly occupational exposure to X-radiation and the magnitudes of organ dosages administered to the patients - for the first time led to quantitative information about the somatically significant dosage the population is exposed to due to roentgenological diagnostic measures. Proposals are made, which concern the performance of radiation protection seminars, for physicians, the organization of radiation protection responsibilities in hospitals and clinics, the determination of maximum permissible doses and the realization of medical supervision of persons occupationally exposed to X-radiation. A new dose magnitude is proposed which equally considers genetic and somatic risks. (DG).

29434 **(INIS-mf—8386) Effects of combined X-radiation and UV-radiation on HeLa cells.** Luible, M. (Muenchen Univ. (Germany, F.R.). Fachbereich Medizin). 22 Apr 1982. 31p. (In German). NTIS (US Sales Only), PC A03/MF A01. Order Number DE84780187.

A combined X-ray-UV irradiation was performed in non-synchronized HeLa-cells. A pre-irradiation with UV-light, that reduced the survival rate to 42% and the following X-ray radiation yielded a similar dose-effect characteristic as with ordinary X-ray irradiation, only its shoulder was smaller. An additive radiation interaction with the cellular molecular structure was observed. A pre-irradiation with X-rays followed by step-wise UV-irradiation yielded a function similar to the UV-action curve but also with a narrower shoulder. A additive effect could be observed. One can conclude from this that in combined irradiation two interacting processes cause the death of the cells. The gene mutations caused by UV-light lead to cell death. X-rays however cause chromosome breaks, that in an unfavourable combination also lead to cell death. The DNA distorsion caused by the UV-light increases the possibility of misrepair. (orig.).

29435 **(LBL—16379) Response of sensitive human ataxia and resistant T-1 cell lines to accelerated heavy ions.** Tobias, C.A.; Blakely, E.A.; Chang, P.Y.; Lommel, L.; Roots, R. (Lawrence Berkeley Lab., CA (USA)). Jul 1983. Contract AC03-76SF00098. 45p. (CONF-830782—4). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE84012247.

From 11. L. H. Gray conference on cellular repair of radiation damage - mechanisms and modifying agents; Glasgow, UK (18 Jul 1983).

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The radiation dose responses of fibroblast from a patient with Ataxia telangiectasis (AT-2SF) and an established line of human T-1 cells were studied. Nearly monoenergetic accelerated neon and argon ions were used at the Berkeley Bevalac with various residual range values. The LET of the particles varied from 30 keV/μm to over 1000 keV/μm. All Ataxia survival curves were exponential functions of the dose. Their radiosensitivity reached peak values at 100 to 200 keV/μm. Human T-1 cells have effective sublethal damage repair as has been evidenced by split dose experiments, and they are much more resistant to low LET than to high LET radiation. The repair-misrepair model has been used to interpret these results. We have obtained mathematical expressions that describe the cross sections and inactivation coefficients for both human cell lines as a function of the LET and the type of particle used. The results suggest either that high-LET particles induce a greater number of radiolesions per track or that heavy-ions at high LET induce lesions that kill cells more effectively and that are different from those produced at low LET. We assume that the lesions induced in T-1 and Ataxia cells are qualitatively similar and that each cell line attempts to repair these lesions. The result in most irradiated Ataxia cells, however, is either lethal misrepair or incomplete repair leading to cell death. 63 references, 10 figures, 1 table.

29436 **(NUREG—1028) Ruptured cesium-137 well-logging source at Shelwell Services, Inc., Hebron, Ohio.** (Nuclear Regulatory Commission, Glen Ellyn, IL (USA). Region III). Apr 1984. 132p. NTIS, PC A07/MF A01 - GPO* $5.50. Order Number DE84901081.

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This report documents the circumstances surrounding the September 13, 1983, cesium-137 sealed source rupture incident at the Shelwell Services, Inc., facility in Hebron, Ohio. It focuses on the period from approximately 4:00 p.m. (EDT) on September 13, 1983 when the source ruptured, to October 5, 1983, when the radiological emergency response aspects of the event were concluded. Information outside these periods is recounted as necessary. The incident resulted in radiation doses to two licensee employees that exceeded the regulatory limits for whole-body and extremity exposures, and contamination of the licensee's facility, private residences, public buildings, and the personal effects of the licensee's employees, families, and friends. The emergency response required the combined efforts of NRC, US Department of Energy, and state personnel. The report describes the factual information and significant findings associated with the event and, thereby, provides a data base for subsequent detailed analyses and recommendations by various NRC offices. 4 references, 30 figures, 4 tables.

29437 **(NUREG/CR—3535) Age-dependent dose-conversion factors for selected bone-seeking radionuclides.** Cristy, M.; Leggett, R.W.; Dunning, D.E. Jr.; Eckerman, K.F. (Oak Ridge National Lab., TN (USA)). Apr 1984. Contract W-7405-ENG-26. 75p. (ORNL/TM—8929). NTIS, PC A04/MF A01; - GPO; GPO Dep. Order Number DE84008313.

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The transuranic elements and the radiostrontiums are bone-seekers and are potentially important contributors to bone dose from releases from a breeder reactor such as the Clinch River Breeder Reactor. Currently available age-specific dose-conversion factors for these nuclides are based on methods of ICRP Publication 2, published in 1959. ICRP Publications 26 and 30, published in 1977 and 1979, outline methodology incorporating new models and new concepts of risk, including consideration of dose to endosteal surfaces and active bone marrow rather than dose to whole bone. This report gives dose-conversion factors for acute intake of a given radionuclide by ingestion or inhalation at various ages from birth to adulthood, using the methodology of ICRP 26 and 30, but modified and extended as appropriate to include age-dependence. Results for 32 isotopes of strontium, plutonium, americium, and curium are tabulated. 79 references, 5 figures, 6 tables.

29438 **(NUREG/CR—3572) Determination of metabolic data appropriate for HLW dosimetry (ICRP-30), I.** Eckerman, K.F.; Leggett, R.W.; Meyer, R.; O'Kelley, G.D. (Oak Ridge National Lab., TN (USA)). May 1984. Contract AC05-84OR21400. 78p. (ORNL/TM—8939). NTIS, PC A05/MF A01; 1 - GPO; GPO Dep. Order Number DE84010646.

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This report provides an initial evaluation of the dependence on chemical forms of estimates of health effects from radionuclides in high-level waste (HLW). Discussion is limited mainly to a review of studies of plutonium, americium, neptunium, and strontium that may be useful in identifying (a) chemical forms of these radionuclides that are likely to reach humans after migration from a waste repository and (b) differences in metabolism and organ doses that result from intake of various chemical forms of these radionuclides; we also attempt to identify research needs in these two areas. In addition to providing a limited review of the literature, this report identifies some of the problems involved in determining speciation of these radionuclides in the environment and provides a general picture of the potential errors that may be involved in applying models assumed to be independent of chemical form to estimate metabolism and dose from exposure to different chemical species of a radionuclide. 76 references, 2 figures, 4 tables.

29439 **(NUREG/CR—3745) Biological characterization of radiation exposure and dose estimates for inhaled uranium milling effluents. Annual progress report April 1, 1982-March 31, 1983.** Eidson, A.F. (Lovelace Biomedical and Environmental Research Inst., Albuquerque, NM (USA). Inhalation Toxicology Research Inst.). May 1984. Contract AC04-76EV01013. 50p. (LMF—108). NTIS, PC A03/MF A01; 1 - GPO $4.00; GPO Dep. Order Number DE84012469.

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The problems addressed are the protection of uranium mill workers from occupational exposure to uranium through routine bioassay programs and the assessment of accidental worker exposures. Comparisons of chemical properties and the biological behavior of refined uranium ore (yellowcake) are made to identify important properties that influence uranium distribution patterns among organs. These studies will facilitate calculations of organ doses for specific exposures and associated health risk estimates and will identify important bioassay procedures to improve evaluations of human exposures. A quantitative analytical method for yellowcake was developed based on the infrared absorption of ammonium diuranate and U_3O_8 mixtures in KBr. The method was applied to yellowcake samples obtained from six operating mills. The composition of yellowcake from the six mills ranged from nearly pure ammonium diuranate to nearly pure U_3O_8. The composition of yellowcake samples taken from lots from the same mill was only somewhat less variable. Because uranium mill workers might be exposed to yellowcake either by contamination of a wound or by inhalation, a study of retention and translocation of uranium after subcutaneous implantation in rats was done. The results showed that 49% of the implanted yellowcake cleared from the body with a half-time (T sub 1/2) in the body of 0.3 days, and the remainder was cleared with a T sub 1/2 of 11 to 30 days. Exposures of Beagle dogs by nose-only inhalation to aerosols of commercial yellowcake were completed. Biochemical indicators of kidney dysfunction that appeared in blood and urine 4 to 8 days after exposure to the more soluble yellowcake showed significant changes in dogs, but levels returned to normal by 16 days after exposure. No biochemical evidence of kidney dysfunction was observed in dogs exposed to the less soluble yellowcake form. 18 figures, 9 tables.

29440 **(ORAU—225) Manpower trends and training requirements for radiation protection personnel in the DOE contractor system.** Trice, J. (Oak Ridge Associated Universities, Inc., TN (USA)). Feb 1984. Contract AC05-76OR00033. 107p. NTIS, PC A06/MF A01; GPO Dep. Order Number DE84010692.

This document reports results of a survey undertaken jointly by the Office of Nuclear Safety and the Office of Industrial Relations, US Department of Energy, with assistance from Oak Ridge Associated Universities. The purpose of the survey was twofold: (1) to determine the current status and recent trends in technician-level radiation safety manpower among DOE contractors; and (2) to document the scope of radiation safety training activities for radiation protection technicians and other workers within the DOE contractor system. Data reported here were obtained both by use of a formal written questionnaire completed by staff at 34 government-owned, contractor-operated (GOCO) nuclear facilities and through supplemental documentation obtained from contractors of training procedures and requirements. The first half of this report describes trends in radiation protection manpower and reports workforce characteristics of health physics technicians. The second half of the report describes program requirements and procedures in those facilities that conduct formal in-house training programs for their radiation protection workforces. 4 figures, 22 tables.

29441 **(ORNL—6021) Biology Division. Progress report, August 1, 1982-September 30, 1983.** (Oak Ridge National Lab., TN (USA)). Jan 1984. Contract W-7405-ENG-26. 258p. NTIS, PC A12/MF A01; GPO Dep. Order Number DE84006248.

The Biology Division is the component of the Oak Ridge National Laboratory that investigates the potential adverse health effects of energy-related substances. The body of this report provides summaries of the aims, scope and progress of the research of groups of investigators in the Division during the period of August 1, 1982, through September 30, 1983. At the end of each summary is a list of publications covering the same period (published or accepted for publication). For convenience, the summaries are assembled under Sections in accordance with the current organizational structure of the Biology Division; each Section begins with an overview. It will be apparent, however, that currents run throughout the Division and that the various programs support and interact with each other.

29442 (ORNL—6021, pp 3-4) **Mechanisms of mutagenesis and DNA repair.** Masker, W.E.; Kuemmerle, N.B.; Dodson, L.A. Jan 1984. NTIS, PC A12/MF A01. Order Number DE84006248. TI84006248

In Biology Division. Progress report, August 1, 1982-September 30, 1983.

The research deals with mechanisms of excision repair in Escherichia coli exposed to chemicals or ultraviolet (uv) radiation. During the past year attention has been focused on the incision proteins that initiate removal of pyrimidine dimers, benzo[a]pyrene adducts, and other bulky lesions from DNA. The product of the E. Coli uvrD gene was isolated and shown to be important in mediating closure of single strand DNA breaks promoted by the incision complex coded for by the uvrA, uvrB, and uvrC gene products. This suggests that the uvrD gene product (now known to be a helicase) is necessary either for dislodging the incision complex from the nicked DNA or for preparing a DNA primer-template configuration suitable for proper repair resynthesis.

29443 (ORNL—6021, pp 29-30) **Respiration shutoff in Escherichia coli after far-uv irradiation.** Swenson, P.A.; Norton, I.L. Jan 1984. NTIS, PC A12/MF A01. Order Number DE84006248. TI84006248

In Biology Division. Progress report, August 1, 1982-September 30, 1983.

Damage to DNA of Escherichia coli by uv, ionizing radiation and chemicals causes a number of responses that require the $recA^+$ and $lexA^+$ gene products. The responses include error prone repair (as indicated by mutagenesis), filamentation and induction of prophage λ. Another important rec/lex response, shutoff of respiration, which occurs 60 min after exposure to uv, is studied. Objective is to understand the genetic and biochemical bases of the shutoff process and its control.

29444 (ORNL—6021, pp 55-62) **Mammalian cytogenetics.** Aardema, M.J.; Au, W.W.; Gooch, P.C.; Heartlein, M.W.; Ho, T.; Luippold, H.E.; O'Neill, J.P.; Payne, H.S.; Preston, R.J. Jan 1984. NTIS, PC A12/MF A01. Order Number DE84006248. TI84006248

In Biology Division. Progress report, August 1, 1982-September 30, 1983.

We have continued our studies of the mechanisms of induction of chromosome aberrations and sister chromatid exchanges (SCE) by chemical and physical agents, and the application of this knowledge to improve the basis for estimating the genetic and carcinogenic risk to man from exposure to such agents. We are also using these mechanistic approaches for the determination of the possible reasons for differences in sensitivity to the induction of chromosome aberrations and SCE in the same cell types of different species and different cell types within a species. We have also applied our information for conducting human population cytogenetic monitoring studies and interpreting the data.

29445 (ORNL—6021, pp 83-85) **Genetics of repair of radiation damage to DNA in bacteria.** Billen, D.; Hadden, C.T. Jan 1984. NTIS, PC A12/MF A01. Order Number DE84006248. TI84006248

In Biology Division. Progress report, August 1, 1982-September 30, 1983.

The purpose of this study was to determine whether chemical protection against single-strand breaks observed in toluene-treated E. coli (AB3063) subjected to X irradiation in air was due to the removal of OH radicals, or resulted from the production of secondary radicals. In toluene-treated cells DNA strand-break production can be measured without the complication of strand ligation during or immediately following x-ray exposure since such cells are deficient in DNA ligase activity.

29446 (ORNL—6021, pp 104-105) **Detailed analysis of radiation-induced litter-size reduction in specific-locus experiments.** Selby, P.B.; Russell, W.L. Jan 1984. NTIS, PC A12/MF A01. Order Number DE84006248. TI84006248

In Biology Division. Progress report, August 1, 1982-September 30, 1983.

A detailed analysis of the records from past specific-locus experiments is in progress. Our analysis of the extent of the litter-size reduction induced by radiation has been completed. The analysis involved approximately 900,000 litters from 14 radiation experiments. It appears that the litter-size reduction at 600 R is 4.12% instead of our earlier crude estimate of 2.96%. Although an adjustment for this new estimate would raise the BEIR estimate of the number of individuals having a serious handcap because of radiation-induced segmental aneuploidy from 0.35 to 0.49 per million for 1 R of low-LET radiation, this analysis strengthens the view that these data clearly indicate that the risk from such induced gross chromosomal damage among liveborn individuals is slight.

29447 (ORNL—6021, pp 107-108) **Response of mouse spermatogonial stem cells to x-ray induction of heritable reciprocal translocations.** Generoso, W.M.; Cain, K.T.; Cacheiro, N.L.A.; Cornett, C.V.; Gosslee, D.G. Jan 1984. NTIS, PC A12/MF A01. Order Number DE84006248. TI84006248

In Biology Division. Progress report, August 1, 1982-September 30, 1983.

We have obtained a good estimate of the shape of the heritable-translocation dose-effect curve for spermatogonial stemcells. Doses of 150, 300, 600, or 1200 R of acute X rays were used. The ascending portion of the humped dose-effect curve fits the linear model very closely. Second, the frequencies of heritable translocations observed in the 600 R x 2 and 500 R x 4 fractionation experiments appear to be within reasonable bounds of what might be expected from additivity. And thirdly, we have obtained the most reliable figure to date for the spontaneous frequency of heritable translocations; based on 5433 tested offspring, this frequency was 1.8×10^{-4}.

29448 (ORNL—6021, pp 122-123) **Meiotic segregation in partially sterile male translocation heterozygotes.** Cornett, C.V.; Cacheiro, N.L.A.; Hitotsumachi, S. Jan 1984. NTIS, PC A12/MF A01. Order Number DE84006248. TI84006248

In Biology Division. Progress report, August 1, 1982-September 30, 1983.

From a study of partially-sterile translocations induced by TEM in male meiotic and postmeiotic stages, a positive correlation was observed between the degree of partial sterility and the frequency at which multivalent chromosomes were observed in diakinesis-metaphase I spermatocytes. In the present study it is being determined whether a similar correlation holds true for translocations derived from exposed spermatogonial stem cells. Two groups of x-ray-induced partially-sterile translocations are included in this study: one group derived from treated spermatogonial stemcells, the other from exposed postmeiotic stages. Results for both the gonial and the postmeiotic groups again indicate a positive correlation between degree of partial sterility and incidence of multiple chromosome associations.

29449 (ORNL—6021, pp 125-126) **Circadian rhythms of spermatogonial stem cells.** Oakberg, E.F.; Cummings, C.C. Jan 1984. NTIS, PC A12/MF A01. Order Number DE84006248. TI84006248

In Biology Division. Progress report, August 1, 1982-September 30, 1983.

In order to examine possible differences in DNA synthetic activity with time of day, mice were given a single intraperitoneal injection of 25 μCi 3H-TdR, irradiated with 300 R 24 h later, and killed 207 h after labeling. This protocol restricts labeling to the long-cycling A/sub s/ spermatogonia. There was a significant effect of time of day, with low values at 9 a.m. and 12 midnight.

29450 (ORNL—6021, pp 126-127) **Effect of age on the spermatogonial stem cell population of the mouse.** Oakberg, E.F.; Cummings, C.C. Jan 1984. NTIS, PC A12/MF A01. Order Number DE84006248. TI84006248

In Biology Division. Progress report, August 1, 1982-September 30, 1983.

Stem-cell numbers decline between 12 weeks and 10 months. The new level is then maintained at 17 and 23 momths of age. Some consistent and as yet unexplained changes in the numbers of differentiating spermatogonia (A_1 through B) and preleptotene spermatocytes occur with increasing age.

29451 (ORNL—6021, pp 148-150) **Radiation immunology.** Perkins, E.H.; Klima, W.C. Jan 1984. NTIS, PC A12/MF A01. Order Number DE84006248. TI84006248

In Biology Division. Progress report, August 1, 1982-September 30, 1983.

Current studies aim to evaluate both immunologic and nonimmunologic mechanisms in the shifts of leukemia incidence. In nonirradiated RFM mice four primary types of leukemia occur (reticulum cell sarcoma, myeloid leukemia, thymic lymphoma and nonthymic lymphome) almost exclusively in the last third of life, reticulum cell sarcoma accounting for 90% of the total. After irradiation thymic lymphoma reaches >60% with an induction period of 5 to 6 months. Myeloid leukemia also increases but the time of occurrence is only slightly advanced.

29452 (ORNL—6021, pp 173-180) **Radiation carcinogenesis.** Ullrich, R.L.; Fry, R.J.M.; Ley, R.D.; Storer, J.B.; Terzaghi, M.; Bowles, N.D.; Jernigan, M.C.; McKeown, C.K.; Satterfield, L.C.; Triplett, L.L. Jan 1984. NTIS, PC A12/MF A01. Order Number DE84006248. TI84006248

In Biology Division. Progress report, August 1, 1982-September 30, 1983.

Studies on neutron carcinogenesis, time-dose relationships, the role of host factors in radiation carcinogenesis, and the dynamics of the carcinogenic process after exposure to radiation and chemicals are reported. Problems are being pursued with in vivo

studies as well as in vitro and in vivo/in vitro approaches. A common theme among all of these studies is the examination of mechanisms and the establishment of general principles which may alow a better understanding of the risks to humans from radiation exposure. Data from all of these studies are also being used to examine more direct methods of extrapolation of animal data to human risks. The program in ultraviolet radiation carcinogenesis (UVR) is concerned with development of model systems, methods and background information necessary for designing quantitative UVR carcinogenesis experiments, the role of interactions of UVR and chemicals, and interactions between ionizing and ultraviolet radiation in skin carcinogenesis.

29453 **Unified approach to age-dependent metabolic modeling.** Crawford-Brown, D.J. (Oak Ridge National Lab., TN). *Health Physics;* **46**: No. 4, 809-832(Apr 1984). Contract W-7405-ENG-26.

A generalized approach for estimating the effect of age on deposition fractions and retention half-times is presented. The theory employs measured physiological and anatomical parameters and relates these to metabolic parameters within a general framework intended for use in setting secondary limits for exposure of the general public. Calculated results indicate that younger ages will be characterized by increased deposition fractions and decreased half-times for retention following radionuclide uptakes. Representative examples are provided for radionuclides of current interest in health physics practice.

29454 **Plutonium partitioning among internal organs.** Thomas, R.G.; Healy, J.W.; McInroy, J.F. (Los Alamos National Lab., NM). *Health Physics;* **46**: No. 4, 839-844(Apr 1984).

An estimate of partitioning of plutonium among skeleton, liver, and other organs is needed to estimate the radiation dose to individual organs. This review was done to provide an analysis of the coefficients currently used for the translocation of plutonium from blood to other organs and excreta. Data from both experimental animals and human autopsy cases were used in this analysis. The analysis of data from 257 experimental animal and 169 human subjects led to a conclusion that a 70-30% split of plutonium distribution between skeleton and liver, respectively, would be appropriate for use in plutonium organ distribution models. The variability of plutonium distribution within all compartments is emphasized, with the conclusion that the coefficients of uptake to individual organs are adequate to estimate average organ doses for an exposed population but use for estimating doses for an individual will lead to uncertain results.

29455 **Biokinetics of inhaled ^{244}Cm oxide in the rat: effect of heat treatment at 1150°C.** Guilmette, R.A.; Kanapilly, G.M.; Lundren, D.L.; Eidson, A.F. (Lovelace Biomedical and Environmental Research Inst., Albuquerque, NM). *Health Physics;* **46**: No. 4, 845-858(Apr 1984). Contract AC04-76EV01013.

A study was conducted in rats to determine solubility and subsequent metabolism of an inhaled aerosol of curium treated at high temperatures. Young adult Fischer-344 rats received a single inhalation exposure to one of three monodisperse aerosols of $^{244}Cm_2O_3$ heat-treated at 1150°. Additionally an injection study with curium citrate was done to define the systemic behavior of Cm in this rat model. The in vivo solubility was inversely related to the aerosol particle size. The relationship of the results of this study to results from other experimental inhalation studies with curium oxide aerosols is discussed, as is the relevance to bioassay interpretation and risk assessment in man.

29456 **Comparison of early lung clearance of yellowcake aerosols in rats with in vitro dissolution and IR analysis.** Damon, E.G.; Eidson, A.F.; Hahn, F.F.; Griffith, W.C. Jr.; Guilmette, R.A. (Lovelace Biomedical and Environmental Research Inst., Albuquerque, NM). *Health Physics;* **46**: No. 4, 859-866(Apr 1984). Contract AC04-76EV01013.

The lung retention of uranium was determined in rats that inhaled aerosols of commercial yellowcake powders obtained from two mills (Mill A and Mill D) and whose chemical composition and solubilities in vitro were significantly different. Analysis by IR absorption indicated Mill A yellowcake contained 82% ammonium diuranate (ADU) and 18% U_3O_8. The Mill D powder contained 25% ADU and 75% U_3O_8. In vitro dissolution studies indicated for the Mill A sample, ~ 85% of the uranium had a dissolution half-time (T/sub 1/2) of < one day, with the remainder dissolving with a half-time of 500 days. For the Mill D sample, 25% had T/sub 1/2/ < one day and 75% had T/sub 1/2/ of 300 days. Groups of 50 rats were exposed by nose-only inhalation to aerosols of either the Mill A or the Mill D yellowcake. Selected tissues and excreta samples were assayed by fluorometry to determine their uranium contents. For the Mill A yellowcake, 78% initial lung burden cleared with T/sub 1/2/ of 0.5 days, and 22% with T/sub 1/2/ of 240 days. For the Mill D yellowcake, 25% initial lung burden cleared with T/sub 1/2/ of 3.5 days and 75% with T/sub 1/2/ of 110 days. Thus, the lung clearance of uranium in the rat mimicked the in vitro dissolution data and supported the contention that ADU should be considered as a Class D compound (T/sub 1/2/ = 0.5 days) and U_3O_8 behaves in the lung as a class Y (T/sub 1/2/ > 100 days) material.

29457 **Accelerated heavy particles and the lens. 1. Cataracogenic potential.** Merriam, G.R.; Worgul, B.V.; Medvedovsky, C.; Zaider, M.; Rossi, H.H. (Columbia Univ., New York, NY). *Radiation Research;* **98**: No. 1, 129-140(Apr 1984). Contract AC02-78EV04733.

The effect of varying doses of accelerated (570 MeV/amu) argon ions on the rat lens is described with detailed observations on the sequence of development of the cataracts, the time-dose relationship, and the analysis of their cataractogenic potential. The relative biological effectiveness (RBE) of the heavy particles for cataract production, compared to low linear energy transfer (LET) radiation (X-rays), has been established. These data indicate that, as with neutrons, the RBE increases with decreasing dose and that at a dose of 0.05 Gy an RBE of about 40 was observed.

29458 **^{211}At radiocolloid therapy: further observations and comparison with radiocollocis of ^{32}P, ^{165}Dy, and ^{90}Y.** Bloomer, W.D.; McLaughlin, W.H.; Lambrecht, R.M.; Atcher, R.W.; Mirzadeh, S.; Madara, J.L.; Milius, R.A.; Zalutsky, M.R.; Adelstein, S.J.; Wolf, A.P. (Harvard Medical School, Boston, MA). *International Journal of Radiation Oncology, Biology and Physics;* **10**: No. 3, 341-348(Mar 1984). Contract AC02-76CH00016.

The therapeutic efficacy of α and β emitting radiocolloids was compared for the treatment of experimental malignant ascites. ^{211}At is an almost pure α-emitter. As ^{211}At-tellurium colloid, the dose survival curve is linear and extrapolates through the origin in a manner similar to other high linear energy transfer radiations. Doses of 25 μ Ci were curative. Less than curative doses showed a graded prolongation of median survival. In cured mice, long term histological changes were seen in thyroid tissue. Acute changes were seen in the gastrointestinal tract as early as 2 hr after radiocolloid adminstration; these changes reached a plateau at 6 hr and were essentially gone 36 hr later. By comparison, radiocolloids of the beta emitters ^{32}P, ^{165}Dy, and ^{90}Y were not curative, but relatively large doses did substantially prolong median survival. The doses for maximal effect were 150 μ Ci ^{32}P-chromic phosphate, 8000 μ Ci ^{165}Dy-ferric hydroxide macroaggregates and 200 μ Ci ^{90}Y-citrate. The most compelling reason for the increased therapeutic efficacy of ^{211}At-tellurium colloid is the direct and densely ionizing character of the emitted alpha radiations.

29459 **Effect of alkali on the size dispersity of mammalian DNA measured by filter elution.** van Ankeren, S.C.; Wheeler, K.T. (Univ. of Rochester, NY). *Biophysical Journal;* **45**: No. 2, 421-429(Feb 1984).

DNA from unirradiated and irradiated cultured 9L rat brain tumor cells was held for varying times in low ionic strength solutions at pH 11.0, 12.3, or 12.9. The effect of this exposure to alkali on the DNA size distribution was determined by comparing the DNA filter elution profiles obtained experimentally with those theoretically predicted for monodispersed and random distributions. At pH 12.3 or 12.9, DNA from cells irradiated with 300 rad eluted with first-order kinetics corresponding to a random DNA was exposed to pH 12.3 for 24 h. At pH 12.3 or 12.9, DNA from unirra-

diated cells eluted initially with complex kinetics that later became linear (18-21 h for pH 12.3 or 13-15 h for pH 12.9), characteristic of a monodispersed DNA size distribution. The median size of the distribution decreased if the irradiated DNA size distribution. Holding either unirradiated or irradiated DNA at pH 11.0, below the critical unwinding pH, produced no effect on the elution profiles. Analysis of these filter elution data indicated that after sufficient exposure to pH 12.3 or 12.9, undamaged DNA molecules from mammalian cells elute as a single-stranded monodispersed size distribution of $\sim 1 \times 10^{10}$ daltons. While the possibility cannot be completely eliminated that this monodispersed size represents an upper limit determined by physical forces, these results, in conjunction with those obtained using other techniques, lend credence to the existence of a nonrandom higher-order structure in mammalian chromosomal DNA.

29460 **Circular DNA unwound by photoproducts other than pyrimidine dimers.** Ciarrocchi, G.; Sutherland, B.M. (Brookhaven National Lab., Upton, NY). *BioScience;* **34**: No. 1, 45-46(Jan 1984).

Agarose gel electrophoresis is discussed for measuring the altered tertiary structure of modified DNA and in particular the alteration of twist angles between adjacent base-pairs. With this technique and substrate it is possible to detect alterations of DNA structure resulting in a change of the degree of supercoiling equivalent to a modification of a fraction of superhelical turn. Altered electrophoretic mobility of DNA topoisomers containing UV photodamages other than pyrimidine dimers were specifically photoreversed by irradiation with photoreactivating light in the presence of Escherichia coli photoreactivating enzyme.

29461 **Radiation inactivation of glutamate dehydrogenase hexamer: lack of energy transfer between subunits.** Kempner, E.S.; Miller, J.H. (National Inst. of Health, Bethesda, MD). *Science (Washington, D.C.);* **222**: 586-589(11 Nov 1983).

The effects of ionizing radiation on glutamate dehydrogenase and on fluorescein isothiocyanate-tagged glutamate dehydrogenase were analyzed by target theory. Enzymatic activity, fluorescence, and the survival of the 56,000-dalton monomer subunit were determined on frozen samples irradiated at -125°C and on lyophilized samples irradiated at either -135°C or +30°C. The effects of temperature were the same for all three parameters. Enzymatic activity was lost after small doses of high-energy electrons, whereas fluorescence and monomer subunits survived much larger doses of radiation. Target analysis revealed that the functional unit size for enzymatic activity was the hexamer, confirming both the earlier radiation study and conventional biochemical analyses. Target sizes obtained from fluorescence and subunit structure measurements were close to that of the monomer. These results indicate that the primary ionization caused by electron bombardment results in damage to a single polypeptide strand and that there is no massive transfer of radiation energy to other units in the hexamer.

29462 **Radiation hazards from ear studies and neckwear.** Lyon, W.S. (Oak Ridge National Lab., TN (USA)). *Radiochemical and Radioanalytical Letters;* **59**: No. 1, 3-6(17 Oct 1983).

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Two extreme examples, the Moessbauer examination of the inner ear and the wearing of jewerly painted with radioactive materials, are given to illustrate the problem of radiation risks to the public. The first one seems obviously harmful (7.5×10^3 R) but is received in the course of a scientific measurement; the other one is quite small (1.2 R) but comes about from an unimportant cause. The question is whether these types of activities should and could be prevented to free the society of every radiation risks.

29463 **Combined hit theory-microdosimetric explanation of cellular radiobiological action.** Dond, V.P.; Varma, M.N. (Brookhaven National Lab., Upton, NY (USA)). pp 81-95 of Biological effects of low-level radiation. Proceedings of an international symposium on the effects of low-level radiation with special regard to stochastic and non-stochastic effects jointly organized by the IAEA and the WHO and held in Venice, Italy, 11-15 April 1983. Vienna, Austria; IAEA (1983). (CONF-830450—; IAEA-SM—266/63). Contract AC02-76CH00016.

From IAEA/WHO symposium on biological effects of low level radiation; Venice, Italy (11 Apr 1983).

Hit theory is combined with microdosimetry in a stochastic approach that explains the observed responses of cell populations exposed in radiation fields of different qualities. The central thesis is that to expose a population of cells in a low-level radiation field is to subject the cells to the potential for interaction with charged particles, quantifiable in terms of the charged particle fluence PHI. When such an interaction occurs there is resulting stochastic transfer of energy to a critical volume (CV) of cross-section σ within the cell(s). The severity of cell injury is dependent on the amount of energy thus imparted, or the hit size. If the severity is above some minimal level, there is a non-zero probability that the injury will result in a quantal effect (e.g., a mutational or carcinogenic initial event, cell transformation). A microdosimetric proportional counter, viewed here as a phantom cell CV that permits measurements not possible in the living cell, is used to determine the incidence of hit cells and the spectrum of hit sizes. Each hit is then weighted on the basis of an empirically determined function that provides the fraction of cells responding quantally, as a function of hit size. The sum of the hits so weighted provides the incidence of quantally responding cells, for any amount of exposure PHI in a radiation field of any quality or mixture of qualities. The hit size weighting function for pink mutations in Tradescantia is discussed, as are its implications in terms of a replacement for relative biological effectiveness and dose equivalent.

5602 Thermal Effects

29464 **High-temperature responses of North American cacti.** Smith, S.D.; Didden-Zopfy, B.; Nobel, P.S. (Univ. of California, Los Angeles). *Ecology;* **65**: No. 2, 643-651(Apr 1984). Contract AC03-76SF00012.

High-temperature tolerances of 14 species of North American cacti were investigated. A reduction in the proportion of chlorenchyma cellb ?taking up a vital stain (neutral red) and reduced nocturnal acid accumulation were used as indicators of high-temperature damage. All species tolerated relatively high tissue temperatures, the mean maximum tolerance being 64°C, with an absolute maximum of 69° for two species of ferocactus. Such tissue tolerances to high temperature may be unsurpassed in vascular plants. Morphological features can affect tissue temperatures. Specifically, thin-stemmed species such as the cylindropuntias attain lower maximum temperatures under identical microclimatic conditions than do more massive species; they also tend to be less tolerant of high-temperature stress. Stem diameter changes of three species of columnar ceriod cacti along a Sonoran Desert latitudinal transect were previously attributed to adaptation to progressively colder temperatures northward. Such changes can also be interpreted as a morphological adaptation to high temperatures, particularly in the southern Sonoran Desert. Interspecific differences in high-temperature tolerance may account for distributional differences among other species. Acclimation of high-temperature tolerances in response to increasing day/night air temperatures was observed in all 14 species, especially at higher growh temperatures. From 40° day/30° night to 50°/40°, the tolerable tissue temperatures increased an average of 6°. Half-times for the acclimation shifts were 1-3d. Although cacti attain extremely high tissue temperatures in desert habitats, tolerance of high temperatures and pronounced acclimation potential allow them to occur in some of the hottest habitats in North America.

5603 Chemicals Metabolism And Toxicity

REFER ALSO TO CITATION(S) 27791, 27791, 27840, 29188, 29208, 29218, 29290, 29301, 29327, 29328, 29341, 29342, 29355, 29441

29465 **(AD-A—137115/2) Protection against trichothecene mycotoxins.** (National Research Council, Washington, DC (USA)). 1983. 238p. NTIS, PC A11/MF A01.

Trichothecenes and their effects on humans have attracted national and international attention because of their reported use in warfare. This study arose out of a concern about such uses and the potential harm these substances could cause among civilian and

military populations that might be exposed to them. Accordingly, this report is intended to assist in the protection not only of U.S. Armed Forces against the adverse effects of trichothecenes but also of civilian populations that may come into contact with these toxins during peace or war. The committee concentrated on the following two major objectives: (1) examination of the environmental and biological behavior of the trichothecene class of mycotoxins to determine what protective measures can be taken and (2) development of the means for optimizing the protection of human beings against the effects of trichothecenes through appropriate prophylaxes and treatments.

29466 **(DOE/OR/21400—T11) Testimony presented to the Massachusetts Department of Public Health, March 19, 1984, Jamaica Plain, Massachusetts.** Griesemer, R.A. (Oak Ridge National Lab., TN (USA)). 19 Mar 1984. Contract AC05-84OR21400. 7p. NTIS, PC A02/MF A01; GPO Dep. Order Number DE84011652.

The testimony relates the witness' experience as Director of the Carcinogenesis Bioassay Program at the National Cancer Institute relating to experiments performed with ethylene dibromide (EDB). NCI conducted carcinogenicity bioassays of EDB in rats and mice by both the oral and inhalation routes of exposure. EDB produced multiple kinds of cancer at multiple body sites, in three strains of rats and two strains of mice, in both sexes, at high incidences, with short latent periods, and by three routes of exposure (oral, inhalation, and skin application). (ACR)

29467 **(FWS/OBS—80/40.1) Effects of air emissions on wildlife resources.** Newman, J.R. (Environmental Science and Engineering, Inc., Gainesville, FL (USA)). May 1980. 38p. NTIS, PC A03/MF A01; - GPO*. Order Number DE84901175.

Incidents of injury and death to wildlife as a result of air emissions have been documented for over 90 years. This report summarizes the known effects of air emissions on wildlife resources. Contamination of wildlife by air emissions can occur in three ways: inhalation, absorption, and ingestion. Ingestion is the most common mode of contamination. Air emissions have caused mortality, debilitating injury, disease, and lowered resistance to stress. Wildlife are indirectly affected by contamination of their food resources and by habitat loss. Wildlife can serve as biological indicators of air quality. Some implications are discussed for wildlife management in regions affected by air emissions. 76 references, 3 figures, 7 tables.

29468 **(FWS/OBS—80/40.2) Potential impacts of low pH on fish and fish populations.** Fritz, E.S. (National Power Plant Team, Ann Arbor, MI (USA)). Oct 1980. 20p. NTIS, PC A02/MF A01; - GPO*. Order Number DE84901177.

Descriptions of the effects of low pH on fish are presented. Subject areas are identified in which further studies are needed. Laboratory experiments show that the toxic effect of low pH differs among species, populations, and age-groups of the same species. Field studies show that the toxicity of low pH is compounded by other water characteristics. Evidence from a number of laboratory and field studies indicate that low pH could increase susceptibility to disease, impair osmoregulation and ionregulation, inhibit hormone production or activity, result in genetic damage, change predator-pray relationships, degrade habitat, and increase the availability of toxic substances. Low pH is shown to result in reproductive failure on the population level, recruitment failure, and on the individual level, cessation of spawning. Slight declines in productivity as they relate to stressed populations, are shown to have the potential to result in unrecoverable drops in population density. 50 references, 3 tables.

29469 **(ORNL—6017) Problem definition study on emission by-product hazards from diesel engines for confined space army workplaces. Final report.** Opresko, D.M.; Holleman, J.W.; Ross, R.H.; Carroll, J.W. (Oak Ridge National Lab., TN (USA)). Apr 1984. Contract AC05-84OR21400. 222p. NTIS, PC A10/MF A01; GPO Dep. Order Number DE84012069.

A review of the available literature was undertaken to identify and characterize diesel exhaust emissions, to identify the factors which determine exhaust composition, to relate the potential effects of exhaust composition to air quality of confined space workplaces, and to evaluate the monitoring and modeling methodology which has been used to ensure that air quality standards are maintained under such conditions. 245 references, 5 figures, 8 tables.

29470 (ORNL—6021, pp 75-79) **Mammalian biochemical genetics.** Popp, R.A.; Popp, D.M. Jan 1984. NTIS, PC A12/MF A01. Order Number DE84006248. TI84006248

In Biology Division. Progress report, August 1, 1982-September 30, 1983.

An ethylnitrosourea induced mutation at the compound globin (Hbb) locus has been identified. The mutation changes the electrophoretic mobility of the majority of the beta-globin polypeptide controlled by the Hbb/sup s/ allele. The specific nature of this mutation is under investigation but it is likely that the electrophoretic mobility change is caused by the substitution of a single amino acid resulting from an ethylnitrosourea induced substitution of a single base in the DNA. Definition of the precise base substitution involved will add to our data base of specific mutations induced by chemicals such as ethylnitrosourea.

29471 (ORNL—6021, pp 86-88) **Analysis of teratogens and potential teratogens using FETAX (frog embryo teratogenesis assay: Xenopus).** Dumont, J.N.; Epler, R.G. Jan 1984. NTIS, PC A12/MF A01. Order Number DE84006248. TI84006248

In Biology Division. Progress report, August 1, 1982-September 30, 1983.

The FETAX assay is rapid and cost effective and uses the developing embryos of the amphibian, Xenopus laevis. Embryos are exposed for 96 hours beginning at the mid to late blastula stage of development. The end-points of the assay are easily scored and provide information on embryotoxicity and teratogenicity, and, in addition, data on the relative toxic or teratogenic potential. FETAX has been validated with 40 known mammalian teratogens and nonteratogens. Those used for validation include pesticides (Carbaryl, Disulfram, Captan, Lindane and Griseofluvin), 2,4-dinitrophenol, propylene glycol, EDTA, meclizine, Velban, vinblastine sulfate, cyclophosphamide, and methotrexate.

29472 (ORNL—6021, pp 93-96) **In-depth study of chemical mutagenesis in mouse germ cells using n-ethyl-n-nitrosourea (ENU) as a model mutagen.** Russell, W.L.; Hunsicker, P.R.; Carpenter, D.A.; Phipps, E.L.; Montgomery, C.S.; Bangham, J.W.; Guinn, G.M.; Steele, M.H.; Thompson, H.M.; Jr. Jan 1984. NTIS, PC A12/MF A01. Order Number DE84006248. TI84006248

In Biology Division. Progress report, August 1, 1982-September 30, 1983.

For the estimation of genetic risk, it is important to know the relative mutational sensitivities of the various germ-cell stages. We have tested the mutational sensitivity of these stages to ENU, because we had discovered that they are extremely sensitive to mutation induction by methylnitrosourea (MNU). Accordingly, we have now performed six replications of an experiment with a 50 mg/kg dose of ENU which does allow some survival of cells in the stages of interest. In matings made in the period between 32 and 42 days after injection (the period that gives the high mutation rate with MNU), we have obtained 4 specific-locus mutations in 5576 offspring. This is a markedly different mutation rate from 1 mutation in 20,836 offspring obtained from matings made in the period before 32 days after injection. Thus, as with MNU, differentiating spermatogonia or early spermatocytes are mutationally sensitive to ENU, and the currently estimated mutation frequency with ENU is similar to that induced by the same dose in stemcell spermatogonia.

29473 (ORNL—6021, pp 96-97) **Use of methylnitrosourea (MNU) as a model mutagen to explore biological variables affecting mutagenicity in mouse germ cells.** Russell, W.L.; Hunsicker, P.R.; Stelzner, K.F.; Maddux, S.C. Jan 1984. NTIS, PC A12/MF A01. Order Number DE84006248. TI84006248

In Biology Division. Progress report, August 1, 1982-September 30, 1983.

In the matings made in the 32 to 42 day period after injection with methylnitrosourea (MNU), 21 specific-locus mutations

were obtained in 10,027 offspring. In all other matings involving post-stemcell stages, (matings made on days 1 to 31 and 43 to 49 after injection) only 3 mutations were obtained in 25,656 offspring. The mutation frequency is slightly, but not significantly, below what would be expected on a linear interpolation between the frequencies at 0 and 75 mg/kg. MNU appears to be more effective than ENU in these mutationally sensitive germ-cell stages, but even at 50 mg/kg of ENU there is clearly more killing of these cells than there is with 44 mg/kg of MNU, and this may obscure the true mutation rate with ENU.

29474 (ORNL—6021, pp 97-98) **Use of MNU-ENU double exposure in the spot test to explore the in vivo action of an O^6 alkyl transferase.** Russell, L.B.; Montgomery, C.S. Jan 1984. NTIS, PC A12/MF A01. Order Number DE84006248. TI84006248

In Biology Division. Progress report, August 1, 1982-September 30, 1983.

Alkylations at the O^6 position of guanine are considered to be more highly mutagenic than alkylations at certain other sites in DNA, possibly explaining, in part, the high mutagenicity of ENU (ethylnitrosourea). Experiments have identified and studied a transferase that de-alkylates the O^6 position, leading to repair of the genetic lesions. There is some evidence that this enzyme may be more effective in removing methyl than ethyl groups. To explore the action of this transferase in mammalian cells in vivo, a mouse spot test in which exposure to MNU (methyl nitrosourea) was followed by ENU-exposure was carried out. Pregnant females at 10-1/4 days of gestation were injected with 3-mg/kg MNU, followed an hour later by 25 mg/kg ENU. The teratogenic effects of ENU (digital anomalies) were greatly enhanced by the pre-treatment with MNU.

29475 (ORNL—6021, pp 98-99) **Specific locus studies with DBCP and HMPA.** Russell, L.B.; Hunsicker, P.R.; Guinn, G.M.; Maddux, S.C.; Montgomery, C.S.; Steele, M.H.; Stelzner, K.F.; Thompson, H.M. Jr. Jan 1984. NTIS, PC A12/MF A01. Order Number DE84006248. TI84006248

In Biology Division. Progress report, August 1, 1982-September 30, 1983.

1,2-Dibromo-3-chloropropane has been shown mutagenic in various systems and is suspected of causing fertility impairments in men, but had not been tested for induction of transmissible effects. A large specific-locus study, toxicity tests, and a fertility experiment have been carried out. The major portion of the specific-locus test (SLT) was carried out with males that received five daily i.p. injections of 80 mg/kg each. These males showed no fertility disturbance at any interval after treatment. A histological study of germ-cell survival in the testis also showed no effect. Hexamethylphosphoramide induces various mutational endpoints in Drosophila, but has yielded conflicting results in mammalian in vitro tests. A specific-locus study of 2000 mg/kg was carried out. No fertility disturbances were noted at any interval after exposure. In the SLT, the spermatogonial stemcell result (no mutations in 20,998 offspring classified) was clearly negative.

29476 (ORNL—6021, pp 99-100) **Effects of inhaled ethylene oxide on induction of heritable gene mutations.** Russell, L.B.; Cumming, R.B.; Hunsicker, P.R.; Bangham, J.W.; Carpenter, D.A.; Phipps, E.L. Jan 1984. NTIS, PC A12/MF A01. Order Number DE84006248. TI84006248

In Biology Division. Progress report, August 1, 1982-September 30, 1983.

In a large-scale inhalation study, male mice were exposed to ethylene oxide in workday periods (6 hours/day, Mondays to Fridays), mostly at the level of 255 ppM. Males were mated to multiple-recessive T-stock females shortly after the end of the inhalation peiod and bred normally for the remainder of the study. Altogether, 71,387 offspring were classified in the experiment and 5 mutations observed, including a cluster of two. EtO thus appears to present a very much smaller risk for induction of gene mutations in stemcell spermatogonia than it does for other genetic endpoints induced in other types of cells.

29477 (ORNL—6021, pp 100-101) **Heritable translocation and dominant-lethal mutation dose-response studies with inhaled ethylene oxide.** Generoso, W.M.; Cain, K.T.; Hoskins, J.B.; Inman, J.R. Jan 1984. NTIS, PC A12/MF A01. Order Number DE84006248. TI84006248

In Biology Division. Progress report, August 1, 1982-September 30, 1983.

During the past year we completed portions of a study to determine the shape of the dose-effect curves for heritable translocations and dominant-lethal mutations induced by inhaled ethylene oxide (EtO). Exposure of parental mice, production of F_1 progeny, and dominant-lethal experiments have already been completed for 250, 204, and 165 ppM concentrations. Results available to date are from the dominant-lethal studies. In matings that took place during the first week posttreatment, the incidences of dominant-lethal mutations were 18%, 22%, and 31% for 165, 204, and 250 ppM concentrations, respectively. This result indicates that dominant-lethal mutations were induced at the three EtO concentrations and that the responses appear not to deviate from a straight line.

29478 (ORNL—6021, pp 101-102) **Non-breeding-test methods for studying induction of dominant skeletal mutations are easily applied to strain used in specific-locus experiments.** Selby, P.B.; Niemann, S.L. Jan 1984. NTIS, PC A12/MF A01. Order Number DE84006248. TI84006248

In Biology Division. Progress report, August 1, 1982-September 30, 1983.

The animals examined were injected with either 300 or 400 mg/kg of ethylnitrosurea. Only offspring derived from treated stem-cell spermatogonia were studied. The frequencies of presumed dominant skeletal mutations following 0, 3 x 100 mg/kg, and 4 x 100 mg/kg of ENU were 2/374, 10/243, and 10/180, respectively. The induced mutation frequencies at the two exposure levels are 3.5 and 5.0%. At the higher exposure, the induced frequency of presumed mutations of a type likely to be of clinical importance is 4.5%. The indices of mutation were 0% in the control, 11.5% in the 3 x 100 mg/kg group, and 12.4% in the 400 mg/kg group. In each case, the increase over the control is statistically significant.

29479 (ORNL—6021, pp 103-104) **Breeding-test experiment shows transmission of many ENU-induced mutations.** Selby, P.B.; Raymer, G.D.; Whitt, B.J.M.; McKinley, T.W. Jr. Jan 1984. NTIS, PC A12/MF A01. Order Number DE84006248. TI84006248

In Biology Division. Progress report, August 1, 1982-September 30, 1983.

Following the finding of the dramatically high mutation frequencies of ethylnitrosourea as evidenced by skeletal deformities, it was decided to test the transmissibility of many of the presumed mutations scored in the non-breeding test studies. Altogether 141 F_1 males were collected and given a chance to sire offspring before they were prepared for skeletal examination. Five of the 114 experimental males were presumed mutants. Two of these failed to sire any offspring. A third male was shown to transmit a mutation having low penetrance for a very severe effect. This male had scoliosis and fusions in the lumbar region and a grossly deformed left hind leg, missing a fibula, most of the tarsals, and two of the digits. One of his daughters was similarly, but more severely, affected. Even with just 1 affected offspring, the frequency of the severe malformation was statistically significantly higher among his total progeny than in the control. The remaining two presumed mutants are still being tested.

29480 (ORNL—6021, pp 105-106) **Cytogenetic analysis of sterile male progeny from mutagen-exposed parents.** Cacheiro, N.L.A.; Cornett, C.V. Jan 1984. NTIS, PC A12/MF A01. Order Number DE84006248. TI84006248

In Biology Division. Progress report, August 1, 1982-September 30, 1983.

Approximately one-third of transmitted reciprocal translocations induced by ionizing radiations or alkylating chemicals in male postmeiotic stages cause complete sterility in male progeny. An experiment was conducted on the ability of methylmercuric hydroxide to increase the incidence of sex-chromosome aneuploids (XXY and XYY conditions are sterile) as a result of induced sex-chromosome nondisjunction in male or female germ cells. In the mercury-

exposed group, there were 17 steriles out of 1267 progeny tested (1.34%), while in the control group there were three steriles out of 1262 tested (0.24%). Analysis of the 17 steriles from the mercury group revealed one XYY and 16 with no detectable chromosomal abnormalities. The three steriles from the control group had no detectable chromosomal abnormalities. These data suggest that the mercury treatment was not effective in inducing sex-chromosome nondisjunction in male and female meiocytes.

29481 (ORNL—6021, pp 108-109) **DNA target sites associated with chemical induction of dominant-lethal mutations and heritable translocations in mice.** Generoso, W.M.; Cain, K.T.; Hoskins, J.B. Jan 1984. NTIS, PC A12/MF A01. Order Number DE84006248. TI84006248

In Biology Division. Progress report, August 1, 1982-September 30, 1983.

It has been postulated that the production of dominant-lethal mutations and heritable translocations is determined by the stability of alkylation products in the chromosomes. If these products are intact in the male chromosomes at the time of sperm entry, they may be repaired in fertilized eggs. If repair is not effected and the alkylation products persist to the time of pronuclear chromosome replication, they lead to dominant-lethality. The production of heritable translocations requires the transformation of unstable alkylation products into lesions that are converted into chromosome exchange after sperm enters the egg but prior to the time of pronuclear chromosome replication.

29482 (ORNL—6021, pp 110-111) **Early embryonic lethality induced by seed oils in female mice treated prior to insemination.** Generoso, W.M.; Hoskins, J.B.; Cain, K.T.; Washington, W.J. Jan 1984. NTIS, PC A12/MF A01. Order Number DE84006248. TI84006248

In Biology Division. Progress report, August 1, 1982-September 30, 1983.

Virgin females 10 to 12 weeks old were given a single i.p. injection of 0.4 ml corn oil. All females were mated during the 6 days following injection and killed for uterine analysis 12 to 15 days after mating. The corn oil-treated groups had up to 30% deciduomata (all three strains were affected), while none of the control groups had more than 5%. To determine whether other oils might produce a similar effect, we tested 0.4 ml single i.p. injections of peanut oil, sesame oil, olive oil, or mineral oil in F_1 females. All three plant oils were found to increase the incidence of deciduomata. Mineral oil, on the other hand, had no effect whatsoever.

29483 (ORNL—6021, pp 111-112) **Restudy of the effectiveness of ingested ethyl alcohol to cause nondisjunction in mouse oocytes.** Washington, W.J.; Cacheiro, N.L.A.; Generoso, W.M. Jan 1984. NTIS, PC A12/MF A01. Order Number DE84006248. TI84006248

In Biology Division. Progress report, August 1, 1982-September 30, 1983.

The dominant-lethal response of female mice given ethyl alcohol orally shortly after mating was investigated. Also, a corresponding cytological analysis of the first postfertilization metaphase prior to first cleavage division was conducted.

29484 (ORNL—6021, pp 112-114) **Development of tests that detect induction of meiotic nondisjunction in mammals.** Russell, L.B. Jan 1984. NTIS, PC A12/MF A01. Order Number DE84006248. TI84006248

In Biology Division. Progress report, August 1, 1982-September 30, 1983.

The discovery in recent years of mouse populations carrying Robertsonian translocations that, in the aggregate, involve all chromosomes has provided tools for the systematic study of the phenotype of animals trisomic or monosomic for any given chromosome. Among chemicals that appear to have produced trisomy by meiotic nondisjunction in mammals are agents that act on DNA (EMS, MMS, 6-mercaptopurine, and possible cyclophosphamide), agents that act on the spindle (colchicine), and agents with largely unknown action (cadmium chloride, halothane, certain hormones). It is noteworthy that agents of the first group have positive results when applied to preleptotene stages of spermatogenesis.

29485 (ORNL—6021, pp 114-115) **Evaluation of existing mutagenicity bioassay for purposes of genetic risk assessment.** Russell, L.B. Jan 1984. NTIS, PC A12/MF A01. Order Number DE84006248. TI84006248

In Biology Division. Progress report, August 1, 1982-September 30, 1983.

It must be assumed that there is a probability of genetic hazard to human beings if mutation induction can be demonstrated in the germline of experimental mammals. However, for a large percentage of chemicals, mammalian germline (MG) mutation data do not yet exist, and efforts to identify possible genetic hazard must be based on results from other tests. An attempt was made to evaluate the degree of reliability with which various types of data may accomplish this task.

29486 (ORNL—6021, pp 115-116) **Chemical dosimetry studies in mammalian germ cells.** Sega, G.A.; Jetton, A.E.; Harvey, H.R.; Owens, J.G.; Hansler, S.C. Jan 1984. NTIS, PC A12/MF A01. Order Number DE84006248. TI84006248

In Biology Division. Progress report, August 1, 1982-September 30, 1983.

Studies of the biochemical interactions of ethyl nitrosourea (ENU) with germ cells in the male mouse were initiated. After an i.p. injection of 50 mg/kg of ^{3}H-labeled ENU, spermatozoa have been recovered from the vasa deferentia of exposed males over a 28-day time period. The alkylation pattern observed showed about a two-fold greater level of sperm-head ethylation 8 to 14 days after treatment. This indicated that late spermatid to early spermatozoal stages were being alkylated somewhat more than the other meiotic and postmeiotic germ-cell stages.

29487 (ORNL—6021, pp 116-117) **DNA repair studies in mammalian germ cells.** Sega, G.A.; Owens, J.G. Jan 1984. NTIS, PC A12/MF A01. Order Number DE84006248. TI84006248

In Biology Division. Progress report, August 1, 1982-September 30, 1983.

In submammalian test systems, nitrosocarbamates (NEC) are 100-fold more mutagenic than are their corresponding nitrosourea homologues. To learn more about its interaction with germ-cell DNA in the mouse testis, male mice were given i.p. injections of NEC. Testicular injections of [^{3}H]dThd were given along with the NEC. Sixteen days after treatment, sperm were recovered from the caudal epididymides and assayed for an unscheduled-DNA-synthesis.

29488 (ORNL—6021, pp 118-119) **DNA damage in mammalian sperm assayed by alkaline elution.** Sega, G.A.; Generoso, E.; Owens, J.G. Jan 1984. NTIS, PC A12/MF A01. Order Number DE84006248. TI84006248

In Biology Division. Progress report, August 1, 1982-September 30, 1983.

Alkaline elution procedures have been used to measure DNA damage in mammalian sperm with at least some classes of chemicals. In the case of MMS and EtO, there is a good correlation between the pattern of DNA elution in the developing sperm of treated mice and the pattern of induced genetic damage. The possibility, therefore, exists for using the alkaline elution procedures we have developed in the mouse to monitor human sperm for DNA breakage that may be correlated with genetic damage.

29489 (ORNL—6021, pp 127) **Lack of effect of DBCP on the mouse testis.** Oakberg, E.F.; Cummings, C.C. Jan 1984. NTIS, PC A12/MF A01. Order Number DE84006248. TI84006248

In Biology Division. Progress report, August 1, 1982-September 30, 1983.

A reduction in sperm count in men exposed to DBCP 91,2-dibromo-3-chloropropane) has been indicated in several publications, and testicular atrophy and dominant lethals have been demonstrated in rats. No effect of DBCP was observed here in mice on the spermatogonial and primary-spermatocyte populations.

29490 (ORNL—6021, pp 133-138) **Systemic toxicology.** Witschi, H.R.; Smith, L.H.; Sigler, C.A.; Morse, C.C.; Martin, F.; Tryka, A.F.; Sendelbach, L.; Stephens, T.J.; Whitaker, M.J.; Goad, M.E. Jan 1984. NTIS, PC A12/MF A01. Order Number DE84006248. TI84006248

In Biology Division. Progress report, August 1, 1982-September 30, 1983.

Work reported here centers around three themes: elucidation of mechanisms of acute and chronic lung injury, evaluation of acute and chronic effects of products associated with synfuel technologies, and validation of the mouse lung tumor assay as a potential short-term in vivo screening assay for suspected carcinogens. In addition a series of new experiments are reported on the effects of the antioxidants butylated hydroxytoluene and butylated hydroxyanisole as modifiers of tumor development in mouse lungs.

29491 (ORNL—6021, pp 138-141) **Induction and progression of neoplasia in tracheal epithelium.** Marchok, A.C.; Phipps, L.H.; Martin, D.H.; Wasilenko, W. Jan 1984. NTIS, PC A12/MF A01. Order Number DE84006248. TI84006248

In Biology Division. Progress report, August 1, 1982-September 30, 1983.

It has been found that the ability of cells to survive the pyruvate deprived medium is a very early marker of carcinogen-induced alterations. It has been determined that pyruvate does not act on normal cells by directly stimulating cell proliferation. However, cells increasingly terminally differentiate toward keratinization and are lost. Normal tracheal cells take up at least 5 times more [^{14}C] pyruvate than carcinogen-altered cells. Carcinogen-altered cells utilize more [^{14}C]-alanine than normal cells. These findings point out the marked changes in metabolism that occur early in carcinogen-altered cells.

29492 (ORNL—6021, pp 141-144) **Inhalation toxicology.** Lock, S.; Stenglein, F.J. Jr. Jan 1984. NTIS, PC A12/MF A01. Order Number DE84006248. TI84006248

In Biology Division. Progress report, August 1, 1982-September 30, 1983.

The work with the diesel fuel aerosols was undertaken to look at the acute effects following single exposure and to study the relative importance of concentration, duration of exposure and frequency of exposure when animals were exposed a total of nine times. The overall conclusion was that low concentrations of diesel fuel aerosol had minimal effects on any of the parameters measured. However, there were some concentration related trends including slower growth with increasing aerosol concentration and changes in certain lung volumes immediately postexposure. The current threshold limit value (TLV) for ethylene oxide (EtO) has been set by OSHA at 50 ppM, but because of health problems associated with exposure to EtO, there are movements to lower the TLV to 1 ppM with a 5 ppM ceiling. One interest is whether EtO can cause mutations or other toxic effects on the hematopoietic system. Male C57BL/6 mice were exposed to 255 ppM (+- 10 ppM) EtO, 6 hours/day, 5 days/week for up to 10 weeks. While no significant mutagenic effects were observed there were some important changes in various cell populations. These changes included loss of granulocytic elements in bone marrow at early time points followed by replacement and hyperproliferation, and a significant depression in lymphocytes in the peripheral blood.

29493 (ORNL—6021, pp 147-148) **Dosimetry of PAH in skin carcinogenesis.** Shugart, L.R.; Holland, J.M.; Chastain, B.H.; Kao, J.Y. Jan 1984. NTIS, PC A12/MF A01. Order Number DE84006248. TI84006248

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Subsequent to topical application of BaP to mouse skin, metabolic activation occurs forming stereospecifically chemically reactive diol epoxides (DE). The primary adduct formed via BaPDE with DNA is anti-BaPDE/deoxyriboguanosine, and there is good correlation between the amount of BaPDE bound to DNA of mouse skin and the carcinogenic activity of BaP. It has been demonstrated that tetrols liberated from BaPDE/DNA adducts by acid hydrolysis are easily quantified by HPLC and fluorescence detection. The mouse skin, in organ culture, has been used to demonstrate its suitability for testing the effect of ellagic acid on adduct formation. Recent studies have shown that ellagic acid inhibits the mutagenicity of anti-BaPDE in Salmonella typhimurium as well as the mutagenic and cytotoxic effects of the compound in Chinese hamster cells, without any detectable harmful activity by itself.

29494 (ORNL—6021, pp 180-182) **Effects of androgens and antiandrogens on the induction of mouse skin papillomas by phorbol ester tumor promoters.** Davidson, K.A. Jan 1984. NTIS, PC A12/MF A01. Order Number DE84006248. TI84006248

In Biology Division. Progress report, August 1, 1982-September 30, 1983.

The skin is a target organ for androgenic steroids. These steroids stimulate cell proliferation in the epidermis and sebaceous glands. Cyproterone acetate (CPA) is a progestin that has antiandrogenic activity. CPA and other antiandrogens block the stimulatory effects of androgens on cell proliferation in the skin. This study evaluates if CPA can inhibit the production of papillomas induced by 12-O-tetradecanoylphorbol-13-acetate (TPA) and studies the influence of host factors (androgens) as modulators in the induction of papillomas.

29495 (ORNL/EIS—203) **Problem definition study of dimethyl sulfoxide (DMSO) and interactive health effects with other chemicals. Final report.** Smith, L.H.; Opresko, D.M.; Holleman, J.W.; Ross, R.H. (Oak Ridge National Lab., TN (USA)). Aug 1983. Contract AC05-84OR21400. 164p. NTIS, PC A08/MF A01; 1; GPO Dep. Order Number DE84011586.

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The major objective of this report is to identify and define, from an evaluation of the available literature, the interactive effects of dimethyl sulfoxide (DMSO) with other chemicals. Both percutaneous and nonpercutaneous routes of exposure are considered, and the chemical agents that are discussed are grouped together by function or effect (e.g., hepatotoxins, anticholinesterases, carcinogens, mutagens, steroids, cytotoxic agents). This discussion is preceded by (1) an overview of the chemistry and physical properties which allow DMSO to function as a super solvent, (2) a brief description of the available techniques for monitoring DMSO in environmental and biological media, and (3) a review of the known and potential toxic effects of DMSO in experimental animals and humans. The report also contains a summary of the regulatory actions which govern the industrial, experimental and therapeutic uses of DMSO. 276 references, 9 figures, 4 tables.

29496 (PB—84-154178) **Safety information profile: overview of building construction, including the use of insulating materials.** Hunt, D.B. (Radian Corp., Salt Lake City, UT (USA)). Apr 1979. 59p. NTIS, PC A04/MF A01.

A safety information profile for the building construction industry, including the use of insulation materials, (Standard Industrial Classifications 15 and 17) is presented. Major areas of construction within each SIC code are described. Potential safety, chemical, and physical hazards are reviewed, and existing controls are discussed. Available accident and illness statistics are presented. Industry growth trends are described. Current federal, industrial, and national consensus standards are described. Names and addresses of industries, associations, unions, and other interested parties are provided. It is concluded that this industry has a historically high rate of injury and illness, and further study is needed to determine causes and prevention. Engineering controls are considered to be the most effective prevention methods. Also recommended is the use of personal protective clothing and equipment.

29497 (PB—84-155563) **Analysis and assessment of incinerated municipal sludge ashes and leachates. Final report, Oct 79-Sep 81.** Theis, T.L.; McKiernan, M.; Padgett, L.E. (Notre Dame Univ., IN (USA)). Feb 1984. 102p. NTIS, PC A06/MF A01.

Research was conducted to analyze the physical and chemical properties of ashes from incinerated municipal sludge and of corresponding dewatered sludge. Samples were gathered from 10 wastewater treatment plants ranging in size from 0.22 to 27.1 cu/sec. These samples were subjected to a series of physical, chemical, and biological tests, including batch and chemical extractions and

the Ames Salmonella assay. Results showed that the addition of supplemental chemicals during wastewater or sludge treatment strongly influenced the leachate properties and composition of both dewatered sludge and ash samples. In the absence of inorganic chemical addition, incineration acted generally to decrease trace metal availability. The behavior of arsenic during the various leaching tests was the opposite of that for metal cations with respect to pH. Incinerated sludges demonstrated weak mutagenic activity in the Ames assay. Four of the 10 ash samples gave positive results, generally in the presence of activating mammalian enzymes. In addition, one dewatered sludge sample also gave positive results . Both frameshift and base-pair mutagens were implicated.

29498 **(PB—84-158617) Avoidance responses of estuarine fish to sulfur dioxide. Final report.** Hall, L.W. Jr; Margrey, S.L.; Graves, W.C. (Johns Hopkins Univ., Laurel, MD (USA). Applied Physics Lab.). Dec 1983. 27p. NTIS, PC A03/MF A01.

This study was designed to determine the avoidance responses of juvenile striped bass, Morone saxatilis, and Atlantic menhaden, Brevoortia tyrannus exposed to sulfur dioxide (sulfite) at acclimation temperatures of 15, 20, 25 and 30C. Predictive models were developed and compared for each species at each acclimation temperature. Acclimation temperature was an important factor influencing the avoidance response of each species exposed to sulfur dioxide. Both species avoided approximately the same concentration of sulfite at 25C. Atlantic menhaden avoided lower concentration of sulfur dioxide than striped bass at 30C.

29499 **(PNL-SA—11829) Usefulness of the lipid index for biouptake studies with Daphnia magna.** Dauble, D.D.; Klopfer, D.C.; Carlile, D.W.; Hanf, R.W. (Pacific Northwest Lab., Richland, WA (USA)). Apr 1984. Contract AC06-76RL01830. 16p. NTIS, PC A02/MF A01; GPO Dep. Order Number DE84011904.

Adult Daphnia magna were starved and monitored for lipid content and brood production. Mean lipid index values declined for 72 hours to less than 50% of 24 hour values. Number of hatched young was inversely related to lipid storage and ovary production. Uptake kinetics of ^{14}C-labelled quinoline was compared between two daphnid test groups with mean lipid scores of 5.4 and 2.8, respectively. Total ^{14}C counts were significantly higher for the high lipid group at 8 hour. Our studies indicated that lipid reserves of daphnid test populations can be routinely monitored as an indicator of environmental stress.

29500 **(UCID—19993) Pollutant body burdens and reproduction in Platichthys stellatus from San Francisco Bay. Annual progress report, year I.** Spies, R.; Rice, D.; Ireland, R.; Beach, J. (Lawrence Livermore National Lab., CA (USA)). Aug 1983. Contract W-7405-ENG-48. 40p. NTIS, PC A03/MF A01; GPO Dep. Order Number DE84011073.

The effects of sublethal levels of pollutants in the tissues of estuarine fish on reproductive success were determined. The relationships among several measures of reproductive success (percent fertilization, hatching success, abnormal larvae) and biochemical measures of pollutant exposure (induced mixed-function oxidase) as well as direct measures of chemical pollutants in tissues were examined. Populations were sampled during active gametogenesis and during the spawning season. Tissues have been preserved for pollutant analyses. The reproductive success of captured spawning females was evaluated, and mixed-function oxidase (MFO) activity measured in captured fish. The results indicate the reproductive success of starry flounder in San Francisco Bay is being impaired by organic pollutants. 14 references, 8 figures, 11 tables.

29501 **Barley growth in coal liquid and diesel liquid fuels from coal and oil: a comparison of potential toxic effects on barley.** Warner, M.L.; Sauer, R.H.; Carlile, D.W. (Pacific Northwest Lab., Richland, WA). *Water, Air, and Soil Pollution;* **22**: No. 1, 47-55(Jan 1984). Contract AC06-76RL01830.

The production of new liquid fuels from coal creates the potential for environmental releases of new products and waste materials via spills or leaching of material from waste storage areas. The chemical composition of these products and waste materials suggests possible toxic effects upon exposed plants and animals. In this study, barley was grown in field lysimeters containing three concentrations (0.07, 0.74, 7.421 m^{-3} equivalent to 80, 800. 8000 gal/acre, respectively) of a sample product blend of Solvent Refined Coal (SRC) heavy and middle distillates. Three methods of soil amendment simulated possible spill clean-up alternatives: adding the coal liquid as a surface layer, as a subsurface layer covered by uncontaminated soil, or intermixed with the top 1 dm of soil. To permit comparison of the coal liquid with familiar commercial material, the study protocol was followed simultaneously in lysimeters amended with #2 diesel fuel. Statistically significant reductions in grain yield were observed for both the SRC and diesel materials for all methods of soil amendment at concentrations equivalent to 0.74 and 7.421 m^{-3}, and for the SRC material only when mixed with soil at a concentration equivalent to 0.071 m^{-3}. Where differences between fuel types were observed, the coal liquid was consistently more toxic.

29502 **Plant uptake assay to determine bioavailability of inorganic contaminants.** Dreesen, D.R.; Cokal, E.J. (Los Alamos National Lab., NM). *Water, Air, and Soil Pollution;* **22**: No. 1, 85-93(Jan 1984). Contract W-7405-ENG-26.

A laboratory technique has been developed to rapidly assess the potential uptake of contaminants by plants growing into waste burial sites. A soil-less planting media was used to provide rapid plant growth and reproducible growing conditions. The uptake of contaminants by several plant species grown on uranium mill tailings materials has been examined. The bioavailability of Mo, Se, Cl, and other trace metals in tailings was greater than in a surface soil from a uranium mining area. Significant differences in nutrient and contaminant contents in aboveground biomass were found between species.

29503 **Flooding and SO_2 stress interaction in Betula papyrifera and B. nigra seedlings.** Norby, R.J.; Kozlowski, T.T. (Oak Ridge National Lab., TN). *Forest Science;* **29**: No. 4, 739-750(Dec 1983). Contract W-7405-ENG-26.

The effects of flooding of soil for 5 weeks and fumigation of shoots with 0.35 ppm SO_2 for 30 hours, alone and in combination, were studied on Betula papyrifera Marsh. (paper birch) and Betula nigra L. (river birch) seedlings. B. papyrifera, an upland species, was adversely affected by flooding more severely than B. nigra, a lowland species. Symptoms of flooding injury in both species included stomatal closure, chlorosis, deterioration of root systems, and greatly reduced dry matter accumulation. Flooding induced formation of hypertrophied lenticels and adventitious roots in B. nigra but not B. papyrifera seedlings. Seedlings of both species recovered 1 to 2 wk after flooding ended and continued growing at a faster rate than unflooded seedlings, thereby partially or completely compensating for the growth-inhibiting effects of flooding. Fumigation with SO_2 at the end of the flooding period induced partial stomatal closure, injury to leaves, and reductions in mean relative growth rates in both species. Stomatal conductance and SO_2 uptake in B. nigra seedlings were reduced 40 to 45 percent by flooding, respectively, and consequently SO_2 caused less visible injury (17 vs. 44 percent of leaf area) and less growth inhibition (0 vs. 26 percent in mean relative root growth rate) in flooded than in unflooded seedlings. Stomatal conductance and SO_2 uptake were reduced even more in flooded B. papyrifera (75 and 77 percent, respectively), yet flooded and unflooded seedlings were similarly affected by SO_2. Flooding stress apparently affected mechanisms of pollution avoidance and pollution tolerance differently in the two species.

29504 **In vitro and in vivo response after exposure to man-made mineral and asbestos insulation fibers.** Pickrill, J.A.; Hill, J.O.; Carpenter, R.L.; Hahn, F.F.; Rebar, A.H. (Lovelace Inhalation Toxicology Research Inst., Albuquerque, NM). *American Industrial Hygiene Association Journal;* **44**: No. 8, 557-561(Aug 1983). Contract AC04-76EV01013.

The relative in vitro and in vivo toxicity of several types of manufactured fibrous glass insulation and crocidolite asbestos was investigated to aid in selection of a suitable glass fiber for subsequent use in inhalation exposures. The in vitro cytotoxicity to pulmonary alveolar macrophages of small glass fibers from microfiber insulation (count median diameter (CMD) ~ 0.1-0.2 μm) was greater than that of the larger fibers from household insulation (CMD ~

2.4 μm). To screen for in vivo pulmonary toxicity, 2-21 mg of glass or asbestos fibers were administered in divided doses to male Syrian hamsters by intratracheal instillation. Animals were sacrificed at 1, 3.5 and 11 months following initial administration of material. One type of glass microfiber count median diameter (CMD) ~ 0.1 μm caused deaths from pulmonary edema at early times after instillation. High levels of asbestos, a second glass microfiber (CMD ~ 0.2 μm) and one type of household insulation fiber (CMD 2.3 μm) all resulted in increases in total collagen and mild pulmonary fibrosis at later times after instillation, although microfiber insulation produced a greater response than household insulation. Asbestos insulation produced the greatest response. A five-day inhalation exposure to a high level of glass microfibers deposited in lung <10 percent of the lowest instilled amount which elicited indications of lung injury. This amount did not produce significant biological changes at 1 to 12 months after exposure. 20 references, 4 figures, 2 tables.

29505 **Impact of ozone on soybean yield.** Kress, L.W.; Miller, J.E. (Argonne National Lab., IL). *Journal of Environmental Quality;* **12**: No. 2, 276-281(Apr-Jun 1983).

Field-grown soybeans [glycine max (L.) Merr., cv. Corosoy] were exposed to O_3 for 7 h daily (0900-1600 CST) for 56 d in open-top chambers. The air in the chambers was either charcoal-filtered or non-filtered, with various constant amounts of O_3 added. The randomized block design incorporated four replicates of six treatments: no chamber (0.042 ppm O_3 seasonal 7-h average); chamber with charcoal-filtered air (0.022 ppm O_3); and chambers with non-filtered air plus added O_3 to provide concentrations of 0.042, 0.064, 0.089, and 0.115 ppm. A linear reduction seed weight per plant with increasing ozone dose (b(slope) = -87.18) was significant (P = 0.01), and yields were reduced 5, 23, 39, and 52% for the 0.042, 0.064, 0.089 and 0115 ppm O_3 treatments, respectively, compared with the 0.022 ppm treatment. Significant (P = 0.01) linear reductions were also noted for filled pods per plant (b = 184.4), seeds per filled pod (b = -0.9955), weight per seed (b = -0.3794), and percent oil content (b = -12.33). Significant (P = 0.01) linear increases were noted for unfilled pods per plant (b - 58.11) and percent protein content (b = 20.58). A comparison of the open plots with the nonfiltered air chamber plots provided with the same concentration of O_3 revealed no significant chamber effect.

29506 **Quality of tomatoes harvested from plants receiving chronic exposures to sulfur dioxide.** Lotstein, R.J.; Davis, D.D.; Pell, E.J. (Pennsylvania State Univ., University Park). *HortScience;* **18**: No. 1, 72-74(1983).

Potted plants of 'Merit' tomato (Lycopersicon esculentum Mill.) were grown from seed to maturity in controlled-environment chambers and exposed to charcoal-filtered air or 288-314 μgm^{-3} (0.11-0.12 ppm) SO_2 during weeks 1-5, 6-10, or 1-10 beginning about one week after transplanting. Red ripe fruit harvested from plants exposed to SO_2 exhibited a slight but significant decrease in ascorbic acid expressed on a dry-weight basis. SO_2 induced significantly greater levels of foliar sulfur, but did not increase sulfur content of the fruit. Exposure of plants to SO_2 did not affect fruit yield or quality factors including soluble solids, total solids, or ascorbic acid on fresh-weight basis. A multiple regression model revealed low but significant R^2 values, indicating a weak and indirect, yet significant, association between plant sulfur content and fruit ascorbic acid.

29507 **Effects of SO_2 on stomatal metabolism in Pisum sativum L.** Rao, I.M.; Amundson, R.G.; Alshcer-Herman, R.; Anderson, L.E. (Univ. of Illinois, Chicago). *Plant Physiology, Supplement;* **72**: 573-577(1983).

Pea (Pisum sativum L. cv 'Little Marvel') plants were exposed to SO_2 for short term (3 hours) and long term (2 days) at 0.2 and at 0.5 microliter per liter (ppm) levels. The effect of this treatment on the activity of phosphoenolpyruvate carboxylase, NAD- and NADP-malate dehydrogenases, and alanine aminotransferase from epidermis and whole leaves was investigated. Short-term exposure to SO_2 at 0.2 or 0.5 ppm decreased the activity of the carboxylase and the dehydrogenases in the epidermis. In contrast, the activity of the same three enzymes increased in whole leaves with either short- or long-term exposure to SO_2. Alanine aminotransferase in epidermis or whole leaves was not much affected by short-term exposure, but the epidermal activity was decreased and whole leaf activity was increased with long-term exposure. SO_2 exposure which was initiated prior to illumination decreased the free thiol content of both epidermis and of whole leaf. Net photosynthesis was reversibly inhibited by long-term exposure to SO_2 at 0.5 ppm. No effect of 0.5 ppm SO_2 on stomatal conductance was detectable after 3 hours. Stomatal conductance appeared to decrease after longer exposure times (2 days) at 0.5 ppm.

29508 **Inhalation of 1-nitropyrene associated with ultrafine insoluble particles or as a pure aerosol: comparison of deposition and biological fate.** Sun, J.D.; Wolff, R.K.; Aberman, H.M.; McClellan, R.O. (Lovelace Biomedical and Environmental Research Inst., Albuquerque, NM). *Toxicology and Applied Pharmacology;* **69**: 185-198(1983). Contract AC04-76EV01013.

The direct-acting mutagen, [^{3}H]nitropyrene (^{3}H-NP), was used as a model nitroaromatic compound. Rats were exposed to this radiolabeled compound by nose-only inhalation either as a coating (~ 6% by mass) on relatively inert, ultrafine $^{67}Ga_2O_3$ particles or as a homogenous ultrafine aerosol. The tissue deposition, retention, and biological fate of each aerosol were investigated and compared. Respiratory tract clearance of ^{3}H radioactivity from each exposure was very rapid with no apparent differences seen in the lung retention of this inhaled compound between each exposure over the course of these studies. Higher ^{3}H-radioactivity levels were seen in stomach and large intestines of rats exposed to the $^{67}Ga_2O_3$-associated ^{3}H-NP than in the same tissues from rats exposed to the pure ^{3}H-NP aerosol. Rats exposed to the ^{3}H-NP-$^{67}Ga_2O_3$ aerosol excreted the majority of the deposited ^{3}H radioactivity in the feces (75 +/- 18%), whereas pure ^{3}H-NP exposed animals excreted a major portion of the radiolabel in the urine (76 +/- 18%). It appeared that the major portion of the pure ^{3}H-NP aerosol was cleared from the respiratory tract by direct absorption into blood, while the $^{67}Ga_2O_3$-associated ^{3}H-NP was cleared by both blood absorption and mucociliary clearance followed by ingestion and fecal excretion. The differences in the deposition and biological fate between the particle-associated NP and the pure NP aerosol may have important implications in terms of the metabolic fate of inhaled nitroaromatic compounds and the health risks associated with human exposures to particulate environmental pollutants that contain this class of compounds.

29509 **Site specific cleavage of θX-174 replicative form DNA after modification by N-acetoxy-N-2-acetylaminofluorene.** Bases, R.; Mendez, F.; Mendez, L. (Albert Einstein Coll. of Medicine, Bronx, NY). *Carcinogenesis (New York);* **4**: No. 11, 1445-1450(1983). Contract AC02-83ER60160.

Three kinds of structural disturbances were found in an 88 base pair (bp) fragment of θX-174 DNA after exposure to N-acetoxy-N-2-acetylaminofluorene (N-Aco-AAF). Frequent strand scissions at two specific guanine sites on the 5′ ^{32}P-end-labeled fragment were identified by base sequence analysis. Scissions at these two sites were induced at neutral pH and they were not increased by treatment with apurinic endonuclease. They are an immediate consequence of N-Aco-AAF action and are not primarily apurinic sites. Alkali treatment with 1 M piperidine at 90°C induced strand scissions at every guanine, demonstrating adduct slices, depurination and strand scissions. Addicted DNA was sensitive to single-strand specific nuclease digestion, suggesting unwound DNA. These studies indicate the predilection of N-Aco-AAF for certain DNA sites and they suggest three kinds of DNA modifications which can be expected after adduction by this carcinogen. Some of the sites may be premutational carcinogen-induced DNA structural modifications.

29510 **Ocular toxicity of 2,2,2-trifluoroethanol in rabbits.** Marshall, T.C.; Hahn, F.F.; Merickel, B.S.; Hobbs, C.H. (Inhalation Toxicology Research Inst., Albuquerque, NM). *Fundamental and Applied Toxicology;* **1**: No. 7-8, 313-318(Jul-Aug 1981). Contract AC04-76EV01013.

Three commercial formulations of 2,2,2-trifluoroethanol (TFE) were applied to eyes of rabbits and evaluated for their potential to cause ocular damage. All three products were severe eye irritants and water irrigation shortly after exposure was not effec-

tive in reducing ocular damage. Gross and histological observations revealed marked conjunctivitis, moderate to severe ulcerative keratitis, and hyperemia and edema of the iris, all of which showed evidence of resolution over the three-week course of investigation. However, complete reversal of all effects was not attained. TFE and its commercial formulations should be viewed as potentially severe human ocular irritants.

29511 **Increase of sister chromatid exchanges and perturbations of cell division kinetics in human lymphocytes by benzene metabolites.** Morimoto, K.; Wolff, S. (Univ. of California, San Francisco). *Cancer Research;* **40**: 1189-1193(Apr 1980).

Benzene, which has been associated with human cancers, is metabolized to produce several major metabolites that could be responsible for the biological effects. Tests have now been carried out on human lymphocytes in culture to determine if benzene or its metabolites, phenol, catechol, and hydroquinone, induce cytogenetic changes and affect the cell cycle. The results indicate that benzene itself does not induce sister chromatid exchanges or affect cell cycle kinetics over a wide range of doses. Catechol is a potent compound that induces sister chromatid exchanges and delays cell division very readily. Hydroquinone is also potent, but less so than catechol. Thus, the formation of catechol and hydroquinone is the most likely cause of benzene toxicity.

57 HEALTH AND SAFETY

29512 **(LBL-PUB—3040) Incidental Crane Operator's Manual: Environmental Health and Safety Department.** (Lawrence Berkeley Lab., CA (USA)). May 1984. Contract AC03-76SF00098. 42p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE84012313.

Portions are illegible in microfiche products.

This manual includes discussions on DOE standards, LBL requirements, terminology, operating procedures, errors, and basic rules. (ACR)

29513 **(ORAU—226) Annual report to the Office of Nuclear Safety, Fiscal Year 1983.** (Oak Ridge Associated Universities, Inc., TN (USA)). May 1984. Contract AC05-76OR00033. 16p. NTIS, PC A02/MF A01; GPO Dep. Order Number DE84012566.

The report presents brief descriptions of Oak Ridge Associated Universities (ORAU) programs supporting the Office of Nuclear Safety (ONS) in the areas of environment, health and safety. Programs include technical support, technical seminars, support of Training Resources and Data Exchange (TRADE) Committee, assistance for the comprehensive appraisal of DOE field offices, technical assistance to the Office of Operational Safety (OOS), technical assistance to Defense Programs, and technical assistance to field offices. (ACR)

29514 **Risk of energy technologies.** Etnier, E.L.; Travis, C.C. (Oak Ridge National Lab., TN). *Nuclear Safety;* **24**: No. 5, 671-677(Sep-Oct 1983).

This article briefly reviews health risk estimates presented in the book, Health Risks of Energy Technologies, sponsored by the American Association for the Advancement of Science. State-of-the-art estimates of the occupational and public health risks associated with nuclear and coal power generation are presented as well as those associated with some of the less conventional energy technologies, including solar power, biomass, and geothermal. Public perception of risk, philosophical attitudes toward risk, and the global ramifications of risk are also discussed. When judged solely on the basis of fatalities and injuries during normal operation and maintenance, it appears that nuclear power produces the least health impact and coal-fired power plants the highest, with the renewable technologies ranging between the two.

58 GEOSCIENCES

5801 Geology And Hydrology

REFER ALSO TO CITATION(S) 27927, 27928, 27929, 27930, 27932, 27933, 27947, 27959, 27974, 29273, 29300

29515 **(CEA-CONF—6898) 500-year isotope record in James Ross: Island snow (Antarctic peninsula).** Aristarain, A.; Jouzel, J.; Pourchet, M. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France); Grenoble-1 Univ., 38 (France)). Aug 1983. 3p. (In French; English). (CONF-8308157—2-Summ.). NTIS (US Sales Only), PC A02/MF A01. Order Number DE84750651.

From 18. assembly of the International Union of Geodesy and Geophysics; Hamburg, F.R. Germany (15 Aug 1983).

Published in summary form only.

29516 **(CEA-CONF—6899) HDO and $H_2{}^{18}O$ atmospheric cycles. Simulation using a general circulation model.** Joussaume, S.; Sadourny, R.; Jouzel, J. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France)). Aug 1983. 3p. (In French and English). (CONF-8308157—6-Summ.). NTIS (US Sales Only), PC A02/MF A01. Order Number DE84750655.

From 18. assembly of the International Union of Geodesy and Geophysics; Hamburg, F.R. Germany (15 Aug 1983).

Published in summary form only.

29517 **(CEA-CONF—6900) Temperature records in Antarctica over the last century as deduced from isotopic data.** Jouzel, J.; Merlivat, L.; Benoist, J.P.; Lorius, C. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France); Grenoble-1 Univ., 38 (France)). Aug 1983. 2p. (In French and English). (CONF-8308157—3-Summ.). NTIS (US Sales Only), PC A02/MF A01. Order Number DE84750652.

From 18. assembly of the International Union of Geodesy and Geophysics; Hamburg, F.R. Germany (15 Aug 1983).

Published in summary form only.

29518 **(CEA-CONF—6901) Recent developments in the isotopic study of hail.** Jouzel, J.; Merlivat, L.; Federer, B. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France)). Aug 1983. 3p. (In French and English). (CONF-8308157—4-Summ.). NTIS (US Sales Only), PC A02/MF A01. Order Number DE84750653.

From 18. assembly of the International Union of Geodesy and Geophysics; Hamburg, F.R. Germany (15 Aug 1983).

Published in summary form only.

29519 **(CEA-CONF—6902) Existence of a kinetic isotopic fractionation effect at snow formation.** Jouzel, J.; Merlivat, L. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France)). Aug 1983. 3p. (In French and English). (CONF-8308157—5-Summ.). NTIS (US Sales Only), PC A02/MF A01. Order Number DE84750654.

From 18. assembly of the International Union of Geodesy and Geophysics; Hamburg, F.R. Germany (15 Aug 1983).

Published in summary form only.

29520 **(CEA-CONF—6903) Comparison between isotopic records in deep-sea cores and in ice cores. Illustration of some problems with a simple climate model.** Le Treut, H.; Jouzel, J. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France)). Aug 1983. 3p. (In French). (CONF-8308157—1-Summ.). NTIS (US Sales Only), PC A02/MF A01. Order Number DE84750650.

From 18. assembly of the International Union of Geodesy and Geophysics; Hamburg, F.R. Germany (15 Aug 1983).

Published in summary form only.

29521 (DOE/ER/13124—1) Structural evolution of the Central Brooks Range, Alaska. Progress report, September 1, 1983-April 10, 1984. Ave Lallemant, H.G. (Rice Univ., Houston, TX (USA)). 1984. Contract AS05-83ER13124. 112p. NTIS, PC A06; 3; GPO Dep. Order Number DE84011617.

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The primary emphasis during the 1983 field season was placed on detailed mapping and structural and stratigraphic analysis of an area near the headwaters of the Hammond River in the Doonerak window. Similar work was started near Coldfoot in the schist and ophiolite belts of the southern foothills of the Brooks Range. A third area north of Anaktuvuk Pass was analyzed in conjunction with a U.S.G.S. project. We started also to analyze seismic reflection profiles from the N.P.R.A. Our preliminary data strongly suggest that the Lower Paleozoic rocks were not deformed during the Innuitian; all generations of structures in the Lower Paleozoic were also found in the younger rocks and were formed during the Juro-Cretaceous Brookian event. The Upper Devonian clastic wedge in the Doonerak area was probably deposited on the southern flank of a foredeep, too far away from the Innuitian fold and thrust belt. All Brookian structures are compatible with one period of north-directed thrusting. The Lower Paleozoic rocks were involved in the thrusting and the antiformal nature of the Doonerak area is the result of the formation of a duplex structure. Structures in the metamorphic rocks of the southern Brooks Range are all correlatable to the ones in the Doonerak area and were thus formed during the Juro-Cretaceous. The so-called ophiolite belt is much less penetratively deformed but was also emplaced by northward thrusting. Major structures in the Anaktuvuk area were formed by northward thrusting, but a distinct EW shortening event has occurred in later times. This EW compression has also been identified in the Doonerak area. 6 references.

29522 Piston corers for peat and lake sediments. Wright, H.E. Jr.; Mann, D.H.; Glaser, P.H. (Univ. of Minnesota, Minneapolis). *Ecology;* **65**: No. 2, 657-659(Apr 1984).

Two pistons corers are described which are successful in cuting the wood or undecomposed fibrous peat that characterizes many peat deposits. These modified corers are equipped with a serrated cutting edge, along with modifications to permit the core tube to be rotated back and forth, so that undecomposed fibers and roots can be cut. Complete sections of peat and even the underlying silt or sand can be acquired to a depth of several meters. The 10-cm diameter corer provides sufficient material for close-interval macrofossil and chemical analysis and for radiocarbon dating. The 5-cm corer is more portable and more convenient.

5802 Geophysics

REFER ALSO TO CITATION(S) 27815, 27927, 27929, 27930, 28381, 29521, 29530

29523 (AD-A—137816/5) Geophysical methodology studies for military groundwater exploration. Final report, Aug 82-Aug 83. Romig, P.R.; Rodriguez, B.D.; Powers, M.H. (Colorado School of Mines, Golden (USA). Exploratory Research Lab.). 31 Jul 1983. 94p. NTIS, PC A05/MF A01.

This report contains the results of geophysical surveys at two sites: White Sands, New Mexico an Fort Carson, Colorado. The geophysical surveys, seismic reflection, seismic refraction, shear wave refraction and reflection, and electrical resistivity, were used in an integrated fashion to detect and assess groundwater potential at a number of locations at each site. The locations presented various geological and groundwater conditions. The results of the surveys varied from fair to good. Factors which contributed to a successful assessment of groundwater potential were: (a) geology consisting of coarse-grained sediments, (b) limited knowledge of geology, and, (c) knowledge of all available geological information. Factors which hindered the assessment of groundwater potential were: (a) geology consisting of fine-grained sediments, (b) complex geology and topography, and (c) no prior knowledge of the geology available. Software developed during this study was designed to allow unskilled military personnel to interpret refraction and reflection data on a small, field-portable microcomputer.

29524 (INIS-BR—106) Aspects of sismo-tectonic stability in the South-Eastern region of Brazil of interest to geology of engineering. Mioto, J.A.; Hasui, Y. (Instituto de Pesquisas Tecnologicas, Sao Paulo (Brazil)). 1982. 8p. (In Portuguese). NTIS (US Sales Only), PC A02/MF A01. Order Number DE84780185.

The occurence of earthquakes in Brazil, mainly in the Southeastern region, and its relationship with the geologic features has been discussed by many authors since the beginning of this century. It is difficult to define intraplate seismicity and to understand the actual epirogenic displacent, but the definition of the regional stability is important for enginnering purposes and have been considered through seismologic, morphotectonic and geologic criteria. (Author).

29525 (PB—84-151307) Numerical modeling of ionospheric parameters from global IMS (International Magnetospheric Study) magnetometer data for the CDAW-6 intervals. Kamide, Y.; Kroehl, H.W.; Hausman, B.A.; McPherron, R.L.; Akasofu, S. (World Data Center A for Solar-Terrestrial Physics, Boulder, CO (USA)). Nov 1983. 208p. (UAG—88). NTIS, PC A10/MF A01.

The purpose of this technical report is to present the results of modeling efforts to estimate the distribution of ionospheric electric potential, ionospheric and field-aligned currents, and Joule heating rate from ground-based magnetic records for two intervals; (1) 0600-1800 UT on March 22, 1979, and (2) 1200 UT on March 31 to 0600 UT on April 1, 1979. This global modeling study constitutes one of the major contributions to the Coordinated Data Analysis Workshop (CDAW-6) sponsored by the National Space Science Data Center, NASA.

29526 (USGS-OFR—83-15) Catalog of earthquakes in Southern Alaska. (Geological Survey, Menlo Park, CA (USA)). 1983. 55p. USGS-Open File Service, Box 25425, Denver Federal Center, Denver, CO 80225. Order Number DE84901199.

This earthquake catalog presents origin times, focal coordinates and magnitudes for 1289 shocks as small as magnitude 1.0 occurring in the third quarter of 1980. 19 references, 9 figures, 1 table. (ACR)

29527 Gas emissions and the eruptions of Mount St. Helens through 1982. Casadevall, T.; Rose, W.; Gerlach, T.; Greenland, L.P.; Ewert, J.; Wunderman, R.; Symonds, R. (Cascades Volcano Observatory, Vancouver, WA). *Science (Washington, D.C.);* **221**: 1383-1385(30 Sep 1983). Contract AC04-76DP00789.

The monitoring of gas emissions from Mount St. Helens includes daily airborne measurements of sulfur dioxide in the volcanic plume and monthly sampling of gases from crater fumaroles. The composition of the fumarolic gases has changed slightly since 1980: the water content increased from 90 to 98 percent, and the carbon dioxide concentrations decreased from about 10 to 1 percent. The emission rates of sulfur dioxide and carbon dioxide were at their peak during July and August 1980, decreased rapidly in late 1980, and have remained low and decreased slightly through 1981 and 1982. These patterns suggest steady outgassing of a single batch of magma has been added since mid-1980. The gas data were useful in predicting eruptions in August 1980 and June 1981.

29528 ASP: an automated seismic processor for microearthquake networks. McEvilly, T.V.; Majer, E.L. (Univ. of California, Berkeley). *Bulletin of the Seismological Society of America;* **72**: No. 1, 303-325(Feb 1982). Contract W-7405-ENG-48.

ASP, a low-power, in-field Automated Seismic Processor of microearthquake network data has been designed, fabricated, and deployed for initial operation in four different field areas to monitor seismicity associated with two geothermal areas (The Geysers, California, and Cerro Prieto, Mexico), a nuclear explosion with its related collapse and aftershock sequence, and late (>1 year) activity in a major aftershock series (Livermore, California). A second ASP system, with a high-speed front-end, is used in acoustic emission (1 to 20 k6Hz) analysis for fracture monitoring. Each of the 15 chan-

nels of ASP (configured for up to 128 channels) automatically detects, measures times and amplitudes, and computes and fits FFT's for both the P and S waves on data sampled at 100 samples/sec. These data from each channel are then processed with a central microprocessor for hypocenter location, running b values, source parameters, event count, and P-wave polarities. The system is capable of processing a 15-station detection in approximately 40 sec, excluding printout. The initial trials have demonstrated that in-field real-time analysis of data maximizes the efficiency of microeathquake surveys allowing flexibility in experimental procedures, with a minimum of the traditional labor-intensive postprocessing. Current efforts are directed toward improving efficiency of computation and data output and in expanding software capabilities.

5803 Mineralogy, Petrology, And Rock Mechanics

REFER ALSO TO CITATION(S) 27955, 27966, 27967, 28835, 28840

5804 Geochemistry

REFER ALSO TO CITATION(S) 27958, 27975, 28886

29529 (PB—84-148493) Manual of analytical methods used at Mintek. Special pub. Stoch, H.; Dixon, K. (Council for Mineral Technology, Randburg (South Africa)). 1983. 317p. NTIS, PC E13/MF E01.

The laboratories of the Council for Mineral Technology (Mintek) were founded in 1934. The name of the organization was originally the Minerals Research Laboratory (M.R.L.), which was changed in 1944 to the Government Metallurgical Laboratory (G.M.L.). As the volume of work was large, the relatively small staff of the Analytical Science Division could not undertake research-and-development work on analytical methods. Fortunately, such work was well-documented and tested by several overseas laboratories, the main methods used being volumetric, gravimetric, and photometric. The next phase in the development of the laboratories commenced at about the time (1966) that the G.M.L. became the National Institute for Metallurgy (NIM). The analytical requests became more varied and more complex, and the demands on the Analytical Science Division necessitated a large amount of research-and-development work to provide the staff with adequate methods for the analysis of base metals of economic importance (copper, lead, zinc, manganese, chromium, etc.), the precious metals (platinum, palladium, rhodium, ruthenium, iridium, osmium, gold, and silver), silicates, trace elements in rocks, ferro-alloys and slags, and impurity elements in high-purity metals. In 1981, NIM was renamed Mintek, and its fields of interest have broadended to cover almost every element or material of economic interest to South Africa. This broadening of interest has led to greater demands from metallurgists and engineers for increased accuracy and a wider range of elemental analyses, and, to satisfy these demands, there has been a concomitant increase in the number of analytical methods developed, some of which require sophisticated instruments for multi-element analysis. This manual of approximately 230 methods of analysis is by no means complete, since it includes only those methods that were investigated in some detail and have been published as unrestricted reports.

5805 Oceanography

REFER ALSO TO CITATION(S) 27956

29530 (PB—84-150168) Beta: a program for calculating and archiving backscattering profiles taken with the NOAA (National Oceanic and Atmospheric Administration) coherent lidar system. Technical memo. Post, M.J.; Morrow, J.F.; Jensen, D.B. (National Oceanic and Atmospheric Administration, Boulder, CO (USA). Wave Propagation Lab.). Nov 1983. 50p. (NOAA-TM-ERL-WPL—113). NTIS, PC A03/MF A01.

The authors document the interactive program BETA to provide to users information about its purpose and its inputs and outputs. More emphasis is placed on running the program and understanding the raw and processed data than is placed on programming particulars.

29531 (WHOI—1-81) Sediment trap intercomparison experiment. Extended Abstracts. (Woods Hole Oceanographic Institution, MA (USA)). Apr 1981. Contract AI01-78EV10059. 123p. (CONF-8011211—Summs.). NTIS, PC A06/MF A01; 1; GPO Dep. Order Number DE84008889.

From Woods Hole Oceanographic Institute conference on sediment trap intercomparison experiment; Woods Hole, MA, USA (13 Nov 1980).

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The report contains extended abstracts describing the research projects carried out under the experiment. They include: fluxes of ^{230}Th and ^{231}Pa measured in deep sea sediment traps; particle sources and sinks from C-FATE (Composition Flux And Transfer Experiments) results; adsorption of particles in the ocean; short duration sediment trap deployments: a means of identifying significant biogeochemical transport processes; organic matter decomposition experiments; sediment trapping in high-energy environments; decomposition of organic matter: preliminary amino acid results from sediment traps at PARFLUX E and the Peru upwelling area; seasonality of carbon fluxes in a temperate environment; the Sediment Trap Intercomparison Experiment - some preliminary data; and aluminum concentrations and fluxes in the ocean.

64 PHYSICS. I.

6401 Astrophysics And Cosmology

REFER ALSO TO CITATION(S) 29132, 29608, 29675

29532 (CONF-8405155—2) Galactic cycles and their relationship to life on earth. Olson, A.P. (Argonne National Lab., IL (USA)). May 1984. Contract W-31-109-ENG-38. 23p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE84011737.

From Inner space/outer space conference; Batavia, IL, USA (2 May 1984).

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This paper draws attention to episodic events in the geologic time scale of the evolution of life on earth, and discusses potentially cyclic behavior relative to galactic structure. The question is a simple one: Do galactic processes affect the solar system? It is known that the sun is moving at about 220 +- 15 km/sec at a distance of about 8.5 +- 0.5 kpc from the galactic center. This motion, if circular and unperturbed, implies an orbital period of 237 +- 21 My for the solar system around the galaxy. The Milky Way also evidences structure typically interpreted as spiral arms, in the distribution of gas clouds in its central plane. The relative motion of the spiral arms, known as the pattern speed, is about 2/3 that of the sun. Consequently the solar system gains upon and passes through all the structure in its orbital plane once in three rotations or ~700 My. If this structure is persistent over times longer than 700 My, it is clear that the interaction (if any) can be called cyclic. Furthermore, if there is any sub-structure or inner pattern to the 700 My cycle, it may show up as higher harmonics. Age estimates for the Milky Way are 12-15 By, or ~17 to 22 structure cycles of 0.70 By. It seems not unreasonable to expect some persistence of a pattern over a few structure cycles. It must be noted that the pattern speed is quite uncertain. Perhaps geophysical evidence can be used to improve on the nominally 700 My structure cycle which is assumed in this paper. 16 references, 8 figures.

29533 (IC—83/16) Metastable vacuum burning phenomenon. Berezin, V.A.; Tkachev, I.I.; Kuzmin, V.A. (International Centre for Theoretical Physics, Trieste (Italy)). Feb 1983. 15p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE84701679.

Equations of motion of an interface between two phases with arbitrary equations of state are obtained. It is found that there may take place a process of metastable vacuum burning. It is shown that under some conditions the process of the new phase bubble expansion is described by the detonation wave equations. Possible cosmological consequences of the metastable phase burning effect are briefly discussed.

29534 **(IC—83/17) Fate of superheavy magnetic monopoles in a neutron star.** Kuzmin, V.A.; Rubakov, V.A. (International Centre for Theoretical Physics, Trieste (Italy)). Feb 1983. 15p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE84701678.

We propose two possible scenarios of the behaviour of superheavy magnetic monopoles in a neutron star, in which the monopole-antimonopole annihilation rate is sufficiently large to prevent the enormous heating of a neutron star due to the monopole induced neutron decays. We find that the galactic monopole flux of order $10^{-16}cm^{-2}s^{-1}ster^{-1}$ can be compatible with the observational limit on the X-ray luminosity of neutron stars.

29535 **(INIS-mf—8371) Spherically symmetric hydrodynamic model calculations on the evolution of interstellar matter and on stellar evolution in the cove of spiral-galaxies.** Loose, H.H. (Goettingen Univ. (Germany, F.R.). Mathematisch-Naturwissenschaftliche Fakultaet). 9 Jul 1981. 107p. (In German). NTIS (US Sales Only), PC A06/MF A01. Order Number DE84780167.

A numerical model is presented for a galactic core with radial symmetry, describing the mechanism of repeated bursts of stellar evolution. Repeated burst occur under the condition that energy is transfered by stellar winds and supernovae explosions from the massive stars, formed in the bursts at high gas pressures, to the interstellar medium. Thus the gas component of the model core expands until massive stars are no longer available. The following contraction of the gas distribution, caused by energy dissipation, results in a new burst, thus starting a new evolutional cycle. In the numerical model a large part of massive stars results in a high production rate for turbulent kinetic energy, so that a repeated excitation of bursts becomes possible.

29536 (INIS-mf—8921, pp 31) **New exact solutions for inhomogeneous universes.** Carmeli, M.; Charach, Ch.; Feinstein, A. (Ben-Gurion Univ. of the Negev, Beersheba (Israel). Dept. of Physics). 1983. NTIS (US Sales Only), PC A05/MF A01. Order Number DE84780235. (CONF-8303128—Summ.). TI84780235

From Israel Physical Society annual meeting; Ramat-Gan, Israel (24 Mar 1983).

29537 (INIS-mf—8921, pp 32) **Feynman propagators in singular cosmological models.** Charach, Ch. (Ben-Gurion Univ. of the Negev, Beersheba (Israel). Dept. of Physics). 1983. NTIS (US Sales Only), PC A05/MF A01. Order Number DE84780235. (CONF-8303128—Summ.). TI84780235

From Israel Physical Society annual meeting; Ramat-Gan, Israel (24 Mar 1983).

29538 (INIS-mf—8921, pp 14) **X-ray emission and cosmological evolution of quasars.** Avni, Y. (Weizmann Inst. of Science, Rehovoth (Israel). Dept. of Physics). 1983. NTIS (US Sales Only), PC A05/MF A01. Order Number DE84780235. (CONF-8303128—Summ.). TI84780235

From Israel Physical Society annual meeting; Ramat-Gan, Israel (24 Mar 1983).

29539 (INIS-mf—8921, pp 14) **Coherent oscillations in x-ray burst sources.** Livio, M. (Technion-Israel Inst. of Tech., Haifa. Dept. of Physics). 1983. NTIS (US Sales Only), PC A05/MF A01. Order Number DE84780235. (CONF-8303128—Summ.). TI84780235

From Israel Physical Society annual meeting; Ramat-Gan, Israel (24 Mar 1983).

29540 (INIS-mf—8921, pp 79) **Density perturbations in anisotropic universes.** Charach, Ch. (Ben-Gurion Univ. of the Negev, Beersheba (Israel). Dept. of Physics). 1983. NTIS (US Sales Only), PC A05/MF A01. Order Number DE84780235. (CONF-8303128—Summ.). TI84780235

From Israel Physical Society annual meeting; Ramat-Gan, Israel (24 Mar 1983).

29541 **(JINR—E-2-82-386) Antiproton interaction with ^{4}He as a test of GUT cosmology.** Chechetkin, V.M.; Khlopov, M.Yu.; Zeldovich, Ya.B.; Sapozhnikov, M.G. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems). 1982. 6p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE84701680.

A new possibility of checking some GUT models is suggested, basing on the analysis of their cosmological consequences and the experimental study of the anti p^{4}He interaction. The study of annihilation of antiprotons with ^{4}He may provide limits on the possible amount of antimatter in the early Universe, limits on the probability of formation of primordial black holes and restrictions on the GUT parameters determining the properties of domains of antimatter.

29542 **Spontaneously broken global symmetries and cosmology.** Shafi, Q.; Vilenkin, A. (Bartol Research Foundation, of the Franklin Institute, University of Delaware, Newark, Delaware 19716). *Physical Review* [*Section*] *D: Particles and Fields;* **29**: No. 8, 1870-1871(15 Apr 1984). Contract AC02-78ER05007.

Phase transitions associated with spontaneously broken global symmetries, in case these occur in nature, can have important cosmological implications. This is illustrated through two examples. The first one shows how the spontaneous breaking of a global U(1) symmetry, present, for instance, in the minimal SU(5) model, can lead to an inflationary phase. The second example illustrates how topologically stable strings associated with the breaking of U(1) symmetry make an appearance at (or near) the end of the inflationary era.

29543 **Strength of ice.** *Energy Technology Review;* 1-13(Apr 1984).

In order to model the evolution and current state of Callisto and Ganymede (Jupiter's two largest moons), which are similar in mass, density, temperature, and apparent composition (about 75% ice by volume) but different in appearance, we are studying the flow properties of ice under extreme conditions. With our new testing apparatus, we have determined that ice is very much weaker at low temperatures (below 160 K) than had been believed. This finding partially explains some of the unusual features found on these Jovian moons, although many questions are still being investigated.

29544 **Dimensional reduction in the early universe: Where have the massive particles gone.** Kolb, E.W. (Fermi National Accelerator Lab., Batavia, IL); Slansky, R. (Los Alamos National Lab., NM). *Physics Letters,* [*Section*] *B;* **135**: No. 5/6, 378-382(16 Feb 1984).

In many models based on reduction from greater than four dimensions, there are absolutely stable particles with masses of order R^{-1} (R is the compactification scale). If the temperature of the universe were ever close to R^{-1}, these massive states would have been present and some would have survived annihilation. We calculate the present mass density due to these particles and find both the five-dimensional model and some versions of $N = 8$ supergravity to be unacceptable. We discuss some possible solutions to this problem.

6402 Atmospheric Physics

29545 **(AD-A—137399/2) Plasma sheet boundary layer. Scientific report 1978-1979.** Eastman, T.E.; Frank, L.A.; Peterson, W.K.; Lennartsson, W. (Iowa Univ., Iowa City (USA). Dept. of Physics and Astronomy). Mar 1983. 60p. NTIS, PC A04/MF A01.

The plasma-sheet boundary layer is a temporally variable transition region located between the magnetotail lobes and the central plasma sheet. We have made a survey of these regions using particle spectra and three-dimensional velocity-space distributions sampled by the ISEE-1 LEPEDEA. Ion composition measurements obtained by the Lockheed ion mass spectrometers indicate that ionospheric ions play a crucial role in magnetotail dynamics. Eleven crossings from the lobes to the central plasma sheet taken at various local times and levels of geomagnetic activity are analyzed in

detail. The average ratios of He(+)/H(+), He(++)/H(+) and O(+)/H(+) are not significantly different between the plasma-sheet boundary layer and central plasma sheet. Intense antisunward-flowing beams of ionospheric origin at E/q of < 1 kV are often seen in the tail lobes, the plasma-sheet boundary layer and, infrequently, in the central plasma sheet. Such beams are not commonly observed in the central plasma sheet which is characterized by hotter and more isotropic ion and electron distributions. Our samples of ion distributions in the plasma-sheet boundary layer frequently show an evolution of distribution functions from highly anisotropic single beams or counter-streaming beams towards the more isotropic distributions typical of the hot component of the central plasma sheet. Provided that the acceleration process for these beams can be identified, we can then account for the transport and injection of hot plasma into the central plasma sheet. We conclude that the plasma-sheet boundary layer is a primary transport region of the magnetotail.

29546 **(FRNC-TH—1352) Experimental study of diffuse auroral precipitations.** Mouaia, K. (Toulouse-3 Univ., 31 (France)). 1983. 116p. (In French). NTIS (US Sales Only), PC A06/MF A01. Order Number DE84750663.

First chapter is devoted to low energy electron precipitation in the evening sector of the auroral magnetosphere, during quiet and disturbed magnetic periods. Four subjects are studied in detail: the latitude distribution of the varied auroral forms and their relations to external magnetosphere; the time coefficients related to precipitations, the form and the dynamic of the diffuse precipitation equatorial frontier; the precipitation effect on the ionosphere concentration. The last part of the chapter shows that the plasma convection in the magnetosphere, associated to wave-particle interactions near the equatorial accounts for the principal characteristics of the evening sector diffuse electronic precipitations. The second chapter deals with subauroral precipitations of low energy ions, after the magnetospheric substorms, in the high latitude regions of the morning sector.

29547 **(LA-UR—84-1199) Electron velocity distributions near collisionless shocks.** Feldman, W.C. (Los Alamos National Lab., NM (USA)). 1984. Contract W-7405-ENG-36. 40p. (CONF-840256—3). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE84011352.

From Chapman conference on collisionless shock waves in the heliosphere; Napa Valley, CA, USA (20 Feb 1984).

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Recent studies of the amount of electron heating and of the shapes of electron velocity distributions across shocks near the earth are reviewed. It is found that electron heating increases with increasing shock strength but is always less than the ion heating. The scale length of electron heating is also less than that for the ions. Electron velocity distributions show characteristic shapes which depend on the strength of the shocks. At the weaker shocks, electron heating is mostly perpendicular to the ambient magnetic field, bar B, and results in Gaussian-shaped velocity distributions at low-to-moderate energies. At the stronger shocks, parallel heating predominates resulting in flat-topped velocity distributions. A reasonable interpretation of these results indicates that at the weaker shocks electron heating is dominated by a tendency toward conservation of the magnetic moment. At the stronger fast-mode shocks, this heating is thought to be dominated by an acceleration parallel to bar B produced by the macroscopic shock electric field followed by beam driven plasma instabilities. Some contribution to the heating at the stronger shocks from conservation of the magnetic moment and cross-field current-driven instabilities cannot be ruled out. Although the heating at slow-mode shocks is also dominated by instabilities driven by magnetic field-aligned electron beams, their acceleration mechanism is not yet established.

29548 **(LA-UR—84-1391) Ion reflection, gyration, and dissipation at supercritical shocks.** Gosling, J.T.; Robson, A.E. (Los Alamos National Lab., NM (USA)). Apr 1984. Contract W-7405-ENG-36. 35p. (CONF-840256—2). NTIS, PC A03/MF A01; GPO Dep. Order Number DE84011353.

From Chapman conference on collisionless shock waves in the heliosphere; Napa Valley, CA, USA (20 Feb 1984).

This brief review emphasizes the following points: (1) Ion reflection is the dominant ion dissipation mechanism at nearly perpendicular, supercritical shocks. (2) An increasing fraction of the ions incident on a supercritical shock is reflected as the Mach number increases. The actual fraction reflected can be predicted using the Rankine-Hugoniot conservation relations. (3) The effective temperature associated with the dispersion in velocity space associated with ion reflection accounts for a large fraction of the temperature rise observed across supercritical, quasi-perpendicular shocks.

29549 **(UCRL—88711) Dynamic characteristic of intense short microwave propagation in an atmosphere.** Yee, J.H.; Alvarez, R.A.; Mayhall, D.J.; Madsen, N.K.; Cabayan, H.S. (Lawrence Livermore National Lab., CA (USA)). Jul 1983. Contract W-7405-ENG-48. 26p. (CONF-830314—7). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE84002788.

From 2. national conference on high power microwave technology; Adelphi, MD, USA (1 Mar 1983).

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The dynamic behavior of an intense microwave pulse which propagates through the atmosphere will be presented. Our theoretical results are obtained by solving Maxwell's equations, together with the electron fluid equations. Our calculations show that although large portions of the initial energy are absorbed by the electrons that are created through the avalanche process, a significant amount of energy is still able to reach the earth's surface. The amount of energy that reaches the earth's surface as a function of initial energy and wave shape after having propagated through 100 km in the atmosphere are investigated. Results for the air breakdown threshold intensity as a function of the pressure for different pulse widths and different frequencies will also be presented. In addition, we will present a comparison between the theoretical and the experimental results for the pulse shape of a short microwave pulse after it has traveled through a rectangular wave guide which contains a section of air. 23 references, 9 figures.

29550 **Pedersen density drift instabilities.** Gary, S.P.; Cole, T.E. (Los Alamos National Lab., NM). *Journal of Geophysical Research;* **88**: No. A12, 10,104-10,110(1 Dec 1983).

This paper describes the linear kinetic theory of electrostatic drift instabilities driven by Pedersen and density drift velocities. The model uses a uniform magnetic field B = zB; a weak, uniform density gradient in the x direction; and a weak, uniform electric field in the y direction. Weak charged-neutral collisions are represented by the addition of BGK model terms to the Vlasov equation. The resulting local dispersion equation is used to study the properties of the associated instabilities at ka/sub i/ ~> 1 (where k is the wave number and a/sub i/ is the ion gyroradius). Results show that the E x B gradient drift instability at ka/sub i/ ~= 1 may grow in the auroral ionosphere primarily in the vicinity of 200 km and only if the electron density is sufficiently small. 2 figures.

29551 **Electron velocity distributions near interplantary shocks.** Feldman, W.C.; Anderson, R.C.; Bame, S.J.; Gosling, J.T.; Zwickl, R.D.; Smith, E.J. (Los Alamos National Lab., NM). *Journal of Geophysical Research;* **88**: No. A12, 9949-9958(1 Dec 1983).

Solar wind electron velocity distributions measured across interplanetary shocks using the Los Alamos plasma analyzer on ISEE 3 have been studied to understand electron heating mechanisms for weak and intermediate strength collisionless shocks. This study thus complements earlier studies of electron heating at the earth's bow shock, an example of a highly supercritical collisionless shock. At the weakest interplanetary shocks (downstream to upstream density ratio N(d/u) ~< 2 and velocity difference V(d-u) ~< 70 km/s), heating perpendicular to the magnetic field B predominates over parallel heating. Such heating may be a consequence of conservation of magnetic moment across the shock. At the stronger interplanetary shocks (N(d/u) ~> 2 and V(d-u) ~> 70 km/s), heating parallel to B is dominant and the downstream velocity distributions are flat-topped, similar to what is observed downstream of the earth's bow shock. This similarity suggests that electron heating in all collisionless shocks with N(d/u) ~> 2 and V(d-u) ~> 70 km/s results in part from an acceleration parallel to

B produced by the macroscopic shock electric field, followed by beam driven plasma instabilities. 14 figures, 4 tables.

6403 Atomic, Molecular, And Chemical Physics

REFER ALSO TO CITATION(S) 29925, 29983, 30071

29552 **(CONF-840403—3) Pressure-dependent electron attachment and breakdown strengths of unitary gases, and synergism of binary gas mixtures: a relationship.** Hunter, S.R.; Christophorou, L.G. (Oak Ridge National Lab., TN (USA); Tennessee Univ., Knoxville (USA). Dept. of Physics). Apr 1984. Contract AC05-84OR21400. 12p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE84011656.

From 4. international symposium on gaseous dielectrics; Knoxville, TN, USA (29 Apr 1984).

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The relationship between the pressure-dependent electron attachment rate constants (k/sub a/) which have been observed in 1-C_3F_6 and in several perfluoroalkanes, and the uniform field breakdown strengths (E/N)/sub lim/ in these gases is discussed. Measurements of the pressure dependence of k/sub a/ of OCS in a buffer gas of Ar are presented and the possible pressure dependence of (E/N)/sub lim/ in OCS is discussed. Uniform field breakdown measurements have been performed in C_3F_8, n-C_4F_{10}, and SO_2 over a range of gas pressures (3 ≦ P/sub T/ ≦ 290 kPa) and are reported. All three molecules have been found to possess pressure-dependent (E/N)/sub lim/ values. The various types of synergistic behavior which have been observed in binary gas dielectric mixtures are summarized and discussed. A new mechanism is outlined which can explain the synergism observed in several gas mixtures where the (E/N)/sub lim/ values of the mixutres are greater than those of the individual gas constituents. Model calculations are presented which support this mechanism, and can be used to explain the pressure-dependent synergistic effects which have been reported in 1-C_3F_6/SF_6 gas mixture.

29553 **(CONF-840403—5) Electron attachment fo halocarbons of interest in gaseous dielectrics.** McCorkle, D.L.; Christodoulides, A.A.; Christophorou, L.G. (Tennessee Univ., Knoxville (USA). Dept. of Physics and Astronomy). 1984. Contract AC05-84OR21400. 11p. NTIS, PC A02/MF A01; GPO Dep. Order Number DE84011668.

From 4. international symposium on gaseous dielectrics; Knoxville, TN, USA (29 Apr 1984).

Total electron attachment rate constants and cross sections for halomethane and haloethane (freon) compounds are summarized and new results are reported for haloethylenes. The relationship between the electron attachment cross section and the breakdown strength of dielectric gases reported earlier is further discussed.

29554 **(CONF-840449—3) Physics of ion sputtering.** Robinson, M.T. (Oak Ridge National Lab., TN (USA)). Apr 1984. Contract AC05-84OR21400. 10p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE84011664.

From 2. symposium on resonance ionization spectroscopy and its applications; Knoxville, TN, USA (16 Apr 1984).

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The ejection of atoms by the ion bombardment of solids is discussed in terms of linear collision cascade theory. A simple argument describes the energies of the ejecta, but elaborate models are required to obtain accurate sputtering yields and related quantities. These include transport theoretical models based on linearized Boltzmann equations, computer simulation models based on the binary collision approximation, and classical many-body dynamical models. The role of each kind of model is discussed. Several aspects of sputtering are illustrated by results from the simulation code MARLOWE. 20 references, 6 figures.

29555 **(CONF-840449—4) Fundamental studies of molecular multiphoton ionization.** Miller, J.C.; Compton, R.N. (Oak Ridge National Lab., TN (USA)). Apr 1984. Contract AC05-84OR21400. 11p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE84011661.

From 2. symposium on resonance ionization spectroscopy and its applications; Knoxville, TN, USA (16 Apr 1984).

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For several years the authors have performed fundamental studies of molecular multiphoton ionization (MPI). We will present a potpourri of techniques and results chosen to illustrate the interesting complexities of molecular MPI. Techniques used include time-of-flight mass spectroscopy, photoelectron spectroscopy, supersonic expansion cooling of molecular beams, harmonic generation, two-color laser MPI, and polarization spectroscopy. Whenever possible the relevance of these results to resonance ionization spectroscopy schemes will be delineated. 23 references, 10 figures.

29556 **(CONF-840449—5) Conceptual basis of resonance ionization spectroscopy.** Payne, M.G. (Oak Ridge National Lab., TN (USA)). Apr 1984. Contract AC05-84OR21400. 9p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE84011662.

From 2. symposium on resonance ionization spectroscopy and its applications; Knoxville, TN, USA (16 Apr 1984).

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Resonance Ionization Spectroscopy (RIS) can b defined as a state-selective detection process in which tunable lasers are used to promote transitions from the selected state of the atoms or molecules in question to higher states, one of which will be ionized by the absorption of another photon. At least one resonance step is used in the stepwise ionization process, and it has been shown that the ionization probability of the spectroscopically selected species can nearly always be made close to unity. Since measurements of the number of photoelectrons or ions can be made very precisely and even one electron (or under vacuum conditions, one ion) can be detected, the technique can be used to make quantitative measurements of very small populations of the state-selected species. Counting of individual atoms has special meaning for detection of rare events. The ability to make saturated RIS measurements opens up a wide variety of applications to both basic and applied research. We view RIS as a specific type of multi-photon ionization in which the goal is to make quantitative measurements of quantum-selected populations in atomic or molecular systems. 16 references.

29557 **(CONF-840449—7) Historical survey of resonance ionization spectroscopy.** Hurst, G.S. (Oak Ridge National Lab., TN (USA)). Apr 1984. Contract AC05-84OR21400. 12p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE84011654.

From 2. symposium on resonance ionization spectroscopy and its applications; Knoxville, TN, USA (16 Apr 1984).

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We have recently celebrated the 10th birthday of Resonance Ionization Spectroscopy (RIS), and this seems an appropriate time to review the history of its development. Basically, RIS is a photophysics process in which tunable light sources are used to remove a valence electron from an atom of selected atomic number, Z. If appropriate lasers are used as the light source, one electron can be removed from each atom of the selected Z in the laser pulse. This implies that RIS can be a very efficient, as well as selective, ionization process. In what we normally call RIS, laser schemes are employed which preserve both of these features. In contrast, multiphoton ionization (MPI) is more general, although not necessarily Z selective or very efficient because resonances are often not used. Early research completed in the USSR and described as selective two-step photoionization, employed resonances to ionize the rubidium atom and served to guide work on laser isotope separation. 29 references, 8 figures.

29558 **(CONF-840449—8) Resonance ionization spectroscopy of argon, krypton, and xenon using vacuum ultraviolet light.** Kramer, S.D. (Oak Ridge National Lab., TN (USA)). Apr 1984. Contract AC05-84OR21400. 9p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE84011655.

From 2. symposium on resonance ionization spectroscopy and its applications; Knoxville, TN, USA (16 Apr 1984).

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Resonant, single-photon excitation of ground state inert gases requires light in the vacuum ultraviolet spectral region. This paper discusses methods for generating this light. Efficient schemes for

ionizing argon, krypton, and xenon using resonant, stepwise single-photon excitation are presented.

29559 **(CONF-840449—9) Isotopically selective counting of noble gas atoms, using resonance ionization spectroscopy.** Chen, C.H. (Oak Ridge National Lab., TN (USA)). Apr 1984. Contract AC05-84OR21400. 7p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE84011638.

From 2. symposium on resonance ionization spectroscopy and its applications; Knoxville, TN, USA (16 Apr 1984).

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The technique of Resonance Ionization Spectroscopy (RIS) is being extended to develop a means for counting individual atoms of a selected isotope of a noble gas. In this method, lasers are used for RIS to obtain atomic species (Z) selectivity and a small quadrupole mass spectrometer provides isotopic (A) selectivity. A progress report on the objective of counting each atom of a particular isotope of a noble gas is given. 10 references, 4 figures.

29560 **(CONF-8404143—3) Dual arc penning ion source gas flow experiments.** Hudson, E.D.; Lord, R.S.; Mallory, M.L.; Antaya, T.A. (Oak Ridge National Lab., TN (USA); Michigan State Univ., East Lansing (USA)). 1984. Contract AC05-84OR21400. 3p. NTIS, PC A02/MF A01; GPO Dep. Order Number DE84011637.

From 10. international conference on cyclotrons and their applications; East Lansing, MI, USA (30 Apr 1984).

Support gas, when added directly to an arc or admitted to an auxiliary chamber of a two-arc chamber ion source, increases the beam intensity for multicharged ions such as $^{16}O^{6+}$. To clarify the mechanism of this intensity increase, gas flow rates from the auxiliary chamber to the main chamber have been measured by using the ORIC cyclotron as a mass spectrometer. The results show that only about three percent of the gas admitted to the auxiliary chamber reaches the main chamber. One can then infer that the improved operation probably results from the stabilizing effect of heating the common cathodes with the auxiliary arc and/or the more favorable distribution of the support gas to the part of the main arc close to the cathodes.

29561 **(DOE/DP/01118—T1) Theoretical atomic and molecular photophysics. Final technical report, October 1, 1981-September 30, 1982.** Eberly, J.H. (Rochester Univ., NY (USA). Dept. of Physics and Astronomy). Apr 1982. Contract AS03-76DP01118. 7p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE84012227.

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Nonlinearities arise in the interaction of light and matter as soon as the light intensity approaches the so-called saturation intensity. It is in this case that an atomic transition stops responding as a harmonic oscillator, and that the atom's inversion begins to play a role in the excitation process. Purely coherent intense plane-wave light gives rise to a variety of remarkable nonlinear effects upon absorption by, or transmission through, a collection of nearly resonant atoms or molecules. In many circumstances, one is interested in the excitation of atomic vapors under conditions that are far from purely coherent or plane-wave in character. Among the more realistic situations encountered in practice are those in which the light is a beam with finite cross section instead of a plane wave, and the atom-light interaction is made partially incoherent by the presence of noise, such as is contributed by collisions of various kinds. In addition, it may not be realistic to treat the absorbing atoms or molecules as if they had a well-defined unique ladder of energy levels through which an electron can be promoted en route to ionization. Few theoretical tools are available for analysis of nonlinear light-matter interactions in these more realistic situations. A brief summary is given here of research into propagation of intense light and dressed atom dynamics.

29562 **(INIS-mf—8391) Measurement of the linear polarization of the photons in the elementary processes of bremsstrahlung production.** Bleier, W. (Tuebingen Univ. (Germany, F.R.). Fakultaet fuer Physik). 17 Feb 1983. 61p. (In German). NTIS (US Sales Only), PC A04/MF A01. Order Number DE84780236.

The polarization of the photons in the elementary processes of the electron-nucleus and electron-electron bremsstrahlung was measured. Electrons with an energy of 300 keV were scattered by copper, gold and carbon target. The polarization in the different processes was measured by using different coincidence methods.

29563 (INIS-mf—8921, pp 45) **Photoionization of xenon involving high excimers.** Steinberger, I.T.; Reininger, R. (Hebrew Univ., Jerusalem (Israel). Racah Inst. of Physics); Bernstorff, S.; Saile, V. (Deutsches Elektronen-Synchrotron (DESY), Hamburg (Germany, F.R.)); Laporte, P. (Centre National de la Recherche Scientifique, Saint-Etienne (France) Equipe de Spectroscopie). 1983. NTIS (US Sales Only), PC A05/MF A01. Order Number DE84780235. (CONF-8303128—Summ.). TI84780235

From Israel Physical Society annual meeting; Ramat-Gan, Israel (24 Mar 1983).

29564 (INIS-mf—8921, pp 46) **Two-states close-coupling electron excitation cross-sections of sodium.** Azar, R.; Shuker, R. (Ben-Gurion Univ. of the Negev, Beersheba (Israel). Dept. of Physics). 1983. NTIS (US Sales Only), PC A05/MF A01. Order Number DE84780235. (CONF-8303128—Summ.). TI84780235

From Israel Physical Society annual meeting; Ramat-Gan, Israel (24 Mar 1983).

29565 (INIS-mf—8921, pp 46) **Drift velocity measurements in relativistic electron beams.** Avivi, P.; Cohen, Ch.; Friedland, L. (Hebrew Univ., Jerusalem (Israel). Racah Inst. of Physics). 1983. NTIS (US Sales Only), PC A05/MF A01. Order Number DE84780235. (CONF-8303128—Summ.). TI84780235

From Israel Physical Society annual meeting; Ramat-Gan, Israel (24 Mar 1983).

29566 (INIS-mf—8921, pp 17) **Evolution of energy bands in rare-gas fluids.** Steinberger, I.T. (Hebrew Univ., Jerusalem (Israel). Racah Inst. of Physics). 1983. NTIS (US Sales Only), PC A05/MF A01. Order Number DE84780235. (CONF-8303128—Summ.). TI84780235

From Israel Physical Society annual meeting; Ramat-Gan, Israel (24 Mar 1983).

29567 (INIS-SU—198, pp 276) **Calculation of probability of Auger KLL transitions in krypton for j-j coupling.** Trusov, V.F.; Ehglajs, M.O.; Anderson, Eh.M. 1983. (In Russian). NTIS (US Sales Only), PC A99/MF A01. Order Number DE84780104. (CONF-8304144—Summs.). TI84780104

From 23. conference on nuclear spectroscopy and nuclear structure; Moscow, USSR (19 Apr 1983).

29568 (INIS-SU—198, pp 238) **Muon conversion in fragments of prompt fission of thorium mesic atom.** Karpeshin, F.F. 1983. (In Russian). NTIS (US Sales Only), PC A99/MF A01. Order Number DE84780104. (CONF-8304144—Summs.). TI84780104

From 23. conference on nuclear spectroscopy and nuclear structure; Moscow, USSR (19 Apr 1983).

29569 (LBL—16281, pp 575-578) **Recent atomic physics experiments at the Bevalac.** Gould, H. Dec 1983. NTIS, PC A99/MF A01. Order Number DE84005862. (CONF-830675—). TI84005862

From 6. high energy heavy ion study and 2. workshop on anomalons; Berkeley, CA, USA (28 Jun 1983).

Recent atomic physics experiments at the Bevalac have concentrated on atomic collisions of very heavy particles, and three of these experiments are outlined here: energy loss by very heavy relativistic nuclei; radiative electron capture; and charge capture and loss by highly stripped uranium. The selection while incomplete is chosen to give an overall view of the atomic physics being studied at the Bevalac. These experiments point the way toward more ambitious experiments as more intense beams become available and experimenters gain experience.

29570 **(LBL—17294-Summ.) Vibrational spectra of CO on Ni (100) studied by infrared emission spectroscopy.** (Lawrence Berkeley Lab., CA (USA)). Feb 1984. Contract AC03-76SF00098. 6p. (CONF-840725—4-Summ.). NTIS, PC A02/MF A01. Order Number DE84009246.

From 3. international conference on infrared physics; Zurich, Switzerland (23 Jul 1984).

We have developed the technique of infrared emission spectroscopy in order to observe vibrational modes of molecules adsorbed on clean, single crystal metal surfaces. A novel apparatus has been constructed which measures the emission from a single crystal sample in thermal equilibrium at room temperature. The apparatus consists of a liquid helium cooled infrared grating spectrometer coupled to an ultrahigh vacuum system equipped with surface preparation and characterization facilities. 3 references, 3 figures.

29571 **(SLAC-CN—250) Engineering basis for selection of positron source material.** Feerick, B. (Stanford Linear Accelerator Center, CA (USA)). 10 Oct 1983. Contract AC03-76SF00515. 14p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE84011772.

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This note describes the engineering basis for the selection of the positron source material. It assumes the approximate physics parameters have already been chosen (i.e. a high Z material of 6 radiation lengths thickness). As part of this study a basic heat transfer analysis of the target was performed and is discussed. It is concluded that Ta-10W is the most likely material to meet required physics parameters and not fail structurally.

29572 **Intense relativistic electron beam propagation in evacuated drift tubes.** O'Shea, P.G.; Welsh, D.; Destler, W.W.; Striffler, C.D. (Laboratory for Plasma and Fusion Energy Studies and the Electrical Engineering Department, University of Maryland, College Park, Maryland 20742). *Journal of Applied Physics;* **55**: No. 11, 3934-3939(1 Jun 1984).

The propagation of a magnetically confined intense relativistic electron beam (IREB) (1 MeV, 27 kA, 20 ns FWHM) in vacuum drift tubes has been studied experimentally and theoretically. Experimental results for current propagation as a function of uniform applied magnetic field (0—1.2 T) are presented for various drift tube diameters, cathode geometries, and anode aperture sizes. An analytic model of laminar beam flow is presented which predicts the space-charge-limited current of a solid IREB propagating in a grounded drift tube. A steady-state equilibrium is examined and is compared with the experimental results.

29573 **Variational calculation of lower vibrational energy levels of formaldehyde X $^1A_1$.** Maessen, B.; Wolfsberg, M. (Department of Chemistry, University of California, Irvine, California 92717). *Journal of Chemical Physics;* **80**: No. 10, 4651-4662(15 May 1984). Contract AT03-76ER70188.

The energies of lower lying vibrational states (J = 0) of formaldehyde in its ground electronic state are calculated variationally for H_2CO and D_2CO. The functions of the basis set correspond to products of harmonic oscillator functions. The full Watson Hamiltonian is used and integrals are evaluated by Gauss—Hermite numerical quadrature. Two different potential functions in internal displacement coordinates, which have been given in the literature, are employed in the calculations. Calculations are carried out for A_1, B_2, and B_1 symmetries with 196, 165, and 108 basis functions, respectively. The forms of some of the eigenvectors are reported.

29574 **Application of fitting laws to rotationally inelastic rate constants: Li_2.** Scott, T.P.; Smith, N.; Pritchard, D.E. (Research Laboratory of Electronics and Department of Physics, Massachusetts Institute of Technology, Cambridge, Massachusetts 02139). *Journal of Chemical Physics;* **80**: No. 10, 4841-4850(15 May 1984).

Using the method of LIF we have measured with an average absolute error of 8% rate constants for rotationally inelastic collisions from level j/sub i/ = 8, 22, and 42 to level j/sub f/ = j/sub i/+Δj for Li_2 ($A\Sigma$) colliding with Xe, Ar, and Ne. Values of 'Δj' up to 32 were studied, involving rotational energy charges as large as 1.5 kT and collisions during which the Li_2 molecule rotated as much as 3 rad. These extremes are several times larger than the corresponding values in any previous experimental studies of rotationally inelastic collisions, and present a formidable challenge both to the experimental technique and to any general relationships used to fit the data. Four parameter fits with average deviation from the data of 11% have been found; these fits combine the energy corrected sudden approximation of DePristo et al. with our recently proposed power law-exponential expression for the basis rates k/sub j/→0 .

29575 **Molecular properties from MCSCF-SCEP wave functions. II. Calculation of electronic transition moments.** Werner, H. (Theoretical Division, MS J569, Los Alamos National Laboratory, Los Alamos, New Mexico 87545). *Journal of Chemical Physics;* **80**: No. 10, 5080-5084(15 May 1984).

A method for calculating first order reduced transition density matrices between general singles-doubles multireference-CI wave functions (MCSCF-SCEP) is presented. The internal coupling coefficients are given in terms of simple overlap and first order transition density matrix elements between a set of N-1 and N-2 electron core functions, which need not necessarily to be orthogonal. As characteristic for the SCEP technique no external coupling coefficients appear in the formalism, and the transition density matrix is obtained in terms of matrix operations involving coefficient matrices and vectors. Some test calculations for the A—X transitions of the OH and CN radicals are presented. The stability of calculated transition moments with respect to the number of reference configurations and the size of the basis sets is investigated. Furthermore, the singles-doubles CI results are compared to those obtained from first order and internal CI wave functions corresponding to the same reference wave function.

29576 **Extraction of H^- beams from a magnetically filtered multicusp source.** York, R.L.; Stevens, R.R. Jr.; Leung, K.N.; Ehlers, K.W. (Los Alamos National Laboratory, Los Alamos, New Mexico 87545). *Review of Scientific Instruments;* **55**: No. 5, 681-686(May 1984). Contract AC03-76SF00098;W-7405-ENG-36.

H^- ions produced by volume processes have been extracted from a multicusp source operated with a magnetic filter and accelerated to form a high-quality beam. It was found that the H^- beam current increased almost linearly with the discharge current. An H^- ion current density of 38 mA/cm² was obtained with a discharge current of approximately 350 A. The accelerated beam was mass analyzed and the emittance of the H^- component was measured. The electron component and the percentage of ion impurity in the extracted beam were also determined.

29577 **Measurement of the positron surface-state lifetime for Al.** Lynn, K.G.; Frieze, W.E.; Schultz, P.J. (Physics Department, Brookhaven National Laboratory, Upton, New York 11973). *Physical Review Letters;* **52**: No. 13, 1137-1140(26 Mar 1984). Contract AC02-76CH00016.

The decay rate has been determined for positrons annihilating with electrons while localized in the image-induced potential well at the (110) surface of a clean well-annealed single crystal of Al at 300 K. The lifetime associated with positrons in this surface state was found to be 580 +- 10 psec. This value, which has never before been directly measured, is in disagreement with present theories. Changes in the lifetime spectra were also found from ion sputtering and from exposure of the surface to various amounts of oxygen.

29578 **Overview of the symposium: status and direction of current research with highly charged ions.** Crandall, D.H. (Oak Ridge National Lab., TN). *Physica Scripta;* **T3**: 249-253(1983). Contract W-7405-ENG-26.

A little of the history preceding the symposium on Production and Physics of Highly Charged Ions is presented as well as a brief summary of some of the flavor of the occasion. The symposium covered a wide range of topics including: ion sources, new experimental techniques, spectroscopy, astrophysics, fusion, electron-ion collisions, and ion-atom collisions. The amount of new experimental data on ion-atom collisions alone was substantial. In all of

the spectroscopy and collisions studies presented, the most universal feature is that the final state of the ion or colliding system is electronically excited. Some of the mechanisms of both formation and decay of the excited states are unique for highly charged ions. Both opportunity and enthusiasm were apparent for continuing atomic physics studies with highly charged ions.

6404 Fluid Physics

REFER ALSO TO CITATION(S) 29548, 29579

29579 (AD-A—137082/4) Kinetic theory of gases, magneto-fluid dynamics and their application. Interim 1 Dec 81-30 Nov 82. Grad, H. (New York Univ., NY (USA). Courant Inst. of Mathematical Sciences). Jan 1983. 24p. NTIS, PC A02/MF A01.

This paper describes research results and cites progress resulting from work performed during this period of the grant. The areas covered in this report are (1) mathematical theory of turbulent fluctuations of a plasma near thermal equilibrium, (2) the theory of non-linear thermal and diffusive waves in finite mass and reacting media, (3) the development of algorithms for the Helmholtz equation, (4) progress in the development of theory for Queer Differential Equations, and (5) spectral theory of non-elliptic operators.

29580 Analytical solutions of model equations for two phase gas mixtures: transverse velocity perturbations. Cavalier, J.F.; Greenberg, W. (Department of Mathematics, West Virginia Institute of Technology, Montgomery, West Virginia 25136). *Physics of Fluids;* **27**: No. 5, 1114-1124(May 1984). Contract AS05-80ER10711.

Model equations for a dilute binary gas system are derived, using a linear BGK scheme. Complete analytical solutions for the stationary half-space problem are obtained for transverse velocity perturbations. The method of solution relies on the resolvent integration technique.

29581 Converging second sound shock waves in superfluid helium. Torczynski, J.R. (Graduate Aeronautical Laboratories, California Institute of Technology, Pasadena, California 91125). *Physics of Fluids;* **27**: No. 5, 1138-1141(May 1984).

A spherical heater and conical channel are used to produce converging second sound shock waves. Arrival time and temperature jump data verify the validity of the weak shock relations. The calculated relative velocities (around 10 m/sec) are the largest ever produced in bulk superfluid helium. Comparison of converging and straight channel experiments shows unambiguously that the phenomena associated with the breakdown of superfluidity in second sound shock experiments occur near the heater, not in the bulk fluid.

6450 High Energy Physics

REFER ALSO TO CITATION(S) 29095

29582 (EP-CPT-RA—1982) 1982. Annual progress report. (Ecole Polytechnique, 91 - Palaiseau (France). Centre de Physique Theorique). 1983. 25p. (In French). NTIS (US Sales Only), PC A02/MF A01. Order Number DE84750662.

This report briefly presents the activities of the Theoretical Physics Center during the year 1982 (elementary particles and plasma).

6451 Particle Interactions And Properties - Experimental

REFER ALSO TO CITATION(S) 30089

29583 (BNL—34569) Nuclear and particle physics aspects of hyperon and antinucleon interactions. Dover, C.B. (Brookhaven National Lab., Upton, NY (USA)). 1984. Contract AC02-76CH00016. 14p. (CONF-8403112—1). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE84010793.

From International symposium on nuclear spectroscopy and nuclear interactions; Osaka, Japan (21 Mar 1984).

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A discussion is given of hyperon (Y) and antinucleon (anti N) interactions with nucleons and nuclei, emphasizing some of the future prospects for nuclear structure and elementary particle physics studies at LEAR or a future kaon factory. The topics addressed include: (1) production and decay of strange dibaryons; (2) spectroscopy of strangeness S = -2 many body systems; (3) N anti N annihilation mechanisms; and (4) inelastic anti N-nucleus scattering and spin-flip excitations in nuclei. 36 references.

29584 (CEA-CONF—6767) Q.C.D. and the transition between "hard" and "soft" scattering at the SPS collider. Peschanski, R. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France)). May 1983. 15p. (CONF-8304153—1). NTIS (US Sales Only), PC A02/MF A01. Order Number DE84750625.

From 11. international winter meeting on fundamental physics; Toledo, Spain (11 Apr 1983).

Studying the features of hard and soft collisions at the SPS collider, we conjecture that a large part of hadronic events are due to "semi-hard" parton-parton collisions accompanied with a large gluon radiation. We show that relevant perturbative QCD calculations give a plausible explanation for the total cross-section rise between ISR and the SPS collider.

29585 (DESY-HERA—83/20) Experimentation at HERA. (Deutsches Elektronen-Synchrotron (DESY), Hamburg (Germany, F.R.); European Committee for Future Accelerators; Nationaal Inst. voor Kernfysica en Hoge-Energiefysica (NIKHEF), Amsterdam (Netherlands)). Oct 1983. 560p. (CONF-8306156—). NTIS (US Sales Only), PC A24/MF A01. Order Number DE84751338.

From Workshop on experimentation at HERA; Amsterdam, Netherlands (9 Jun 1983).

These proceedings contain three articles concerning the physics which can be studied by HERA, which were presented at the named workshop, together with convenor reports on working groups which concern technologies, the intersecting regions, photoproduction at HERA, currents and structure functions, exotic phenomena at HERA, and the use of existing detectors. Finally the experimental halls at HERA are described. Separated abstracts were prepared for the articles in these proceedings.

29586 (DESY-HERA—83/20, pp 3-37) **Virtues of HERA.** Maiani, L. Oct 1983. NTIS (US Sales Only), PC A24/MF A01. Order Number DE84751338. (CONF-8306156—). TI84751338

From Workshop on experimentation at HERA; Amsterdam, Netherlands (9 Jun 1983).

After a general survey of the current status of high energy physics the author discusses the physics which can be studied by HERA. In this framework he considers deep inelastic ep scattering, studies of weak interactions by charged-current ep scattering and the production of new leptons in such processes, the search for supersymmetric particles, and the study of a possible compositeness of quarks and leptons.

29587 **(DESY-L-Trans—287) Limitations on parameters of neutrino oscillations according to data for quasielastic scattering of neutrino beams at the Serpukhov Institute of High Energy Physics.** Belikov, S.V.; Volkov, A.A.; Kochetkov, V.I.; Mukhin, A.I.; Sviridov, Yu.M.; Shestermanov, K.E. (Deutsches Elektronen-Synchrotron (DESY), Hamburg (Germany, F.R.)). Jan 1984. 6p. Deutsches Elektronen-Synchrotron (DESY), Hamburg (Germany, F.R.).

Translated from Russian. Published in Pisma Zh. Tekh. Fiz v. 38(11) (1983) p. 547-550.

Limitations on parameters of muon neutrino oscillations νsub(μ) -> νsub(x) are presented, which were found on the basis of an analysis of quasielastic scattering data in a joint experiment of the Serpukhov Inst. High Energy Physics and the Moscow Inst. Theor. Exp. Phys. at neutrino beams of the Serpukhov Institute. For values of squared mass difference: $\Delta m^2 >$ or approx. 15 eV^2, the mixing coefficient sin^{2}2THETA< or approx.9x10^{-2} at a confidence level of 90%.

29588 **(DOE/ER/01428—504) Test of quantum electrodynamics using the reaction $e^+e \rightarrow \gamma\gamma$ at $\sqrt{s} = 29$ GeV.** Wood, D.E. (Purdue Univ., Lafayette, IN (USA)). May 1984. Contract AC02-76ER01428. 113p. (PU—84-511). NTIS, PC A06/MF A01; 1; GPO Dep. Order Number DE84011609.

Portions are illegible in microfiche products; Thesis.

Study of the reaction $e^+e^- \rightarrow \gamma\gamma$ has been done at a center-of-mass energy of 29 GeV. A data sample from an integrated luminosity of 17.8 pb^{-1} was used. A total of 1806 events was found. The γ rays were detected in the barrel electromagnetic calorimeter of the HRS in the range of polar angles $57^0 < \theta < 123^0$. The angular distributions of $e^+e^- \rightarrow \gamma\gamma$ were compared to third-order QED by using the Berends and Kleiss event generation and a simulation of the detector. 22 references

29589 **(DOE/ER/10667—5) Task A. Study of large P/sub T/ direct photon production at the ISR. Task B. Direct photon production at the tevatron (E-706). Task C. Search for fractional charge particles in semiconductors. Progress report, June 1, 1983-May 31, 1984.** Cleland, W.E.; Coon, D.D.; Engels, E. Jr.; Shepard, P.F.; Thompson, J.A. (Pittsburgh Univ., PA (USA). Dept. of Physics and Astronomy). Jan 1984. Contract AC02-80ER10667. 105p. NTIS, PC A06/MF A01; 1; GPO Dep. Order Number DE84011503.

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Task A is the Pitt contingent of the Axial Field Spectrometer Collaboration, performing experiment R807/808 at CERN. The experiment has studied several topics related to study of high P/sub T/ phenomena such as production of jets at high E/sub T/ and a comparison of their properties with jets seen in e^+e^-. We are working primarily on those aspects of the experiment involving reactions with photons in the final state. We are completing an analysis of prompt photons and pions produced at 11° in the center of mass, from data taken in 1982. Presently, new data are being taken with two large NaI arrays in place. With these data, we are studying low P/sub T/ (20 to 200 MeV/c) photon production as well as prompt photons in the range 1.5 < P/sub T/ < 4 GeV/c. For the 1.5 - 4 GeV/c data we plan to compare single photon production in pp and anti pp collisions. Task B is the Pitt contingent of the E706 collaboration, which is studying prompt photon production in πp and pp collisions at the Tevatron. The major contribution of the Pitt effort to the experiment is the provision of the array of semiconductor detectors required for the charged particle spectrometer to be used in the study of correlated hadronic jets. Task C is the search for fractional charge in semiconductors. Although the physics goals of this experiment are removed from those of the other tasks, the technical overlap with task B is extremely important. The construction and testing of semiconductor detectors requires specialized semiconductor physics knowledge and instrumentation, both of which are being developed concurrently by these two tasks. 109 references.

29590 **(DOE/ER/40103—T1) High Energy Physics Group. Annual progress report, fiscal year 1983.** (Hawaii Univ., Honolulu (USA). Dept. of Physics and Astronomy). 20 Jul 1983. Contract AC03-83ER40103. 123p. NTIS, PC A06/MF A01; 1; GPO Dep. Order Number DE84010325.

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Perhaps the most significant progress during the past twelve months of the Hawaii experimental program, aside from publication of results of earlier work, has been the favorable outcome of several important proposals in which a substantial fraction of our group is involved: the Mark II detector as first-up at the SLC, and DUMAND's Stage I approval, both by DOE review panels. When added to Fermilab approval of two neutrino bubble-chamber experiments at the Tevatron, E632 and E646, the major part of the Hawaii experimental program for the next few years is now well determined. Noteworthy in the SLAC/SLC/Mark II effort is the progress made in developing silicon microstrip detectors with microchip readout. Results from the IMB(H) proton decay experiment at the Morton Salt Mine, although not detecting proton decay, set the best lower limit on the proton's lifetime. Similarly the Very High Energy Gamma Ray project is closely linked with DUMAND, at least in principle, since these gammas are expected to arise from pi-zero decay, while the neutrinos come from charged meson decay. Some signal has been seen from Cygnus X-3, and other candidates are being explored. Preparations for upgrading the Fermilab 15' Bubble Chamber have made substantial progress. Sections of the Progress Report are devoted to VAX computer system improvements, other hardware and software improvements, travel in support of physics experiments, publications and other public reports, and last analysis of data still being gleaned from experimental data taken in years past (PEP-14 and E546, E388). High energy physics theoretical research is briefly described. (WHK)

29591 **(DOE/SF/00235—T3) Annual progress report of the High Energy Physics Group.** (Hawaii Univ., Honolulu (USA). Dept. of Physics and Astronomy). 20 Jul 1983. Contract AM03-76SF00235. 123p. NTIS, PC A06/MF A01; 1; GPO Dep. Order Number DE84011457.

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Perhaps the most significant progress during the past twelve months of the Hawaii experimental program has been the favorable outcome of several important proposals: the Mark II detector as first-up at the SLC, and DUMAND's Stage I approval, both by DOE review panels. When added to Fermilab approval of two neutrino bubble-chamber experiments at the Tevatron, E632 and E646, the major part of the Hawaii experimental program for the next few years is now well determined. Noteworthy in the SLAC/SLC/Mark II effort is the progress made in developing silicon microstrip detectors with microchip readout. This development promises to solve the cost/space problem of 50,000 channel secondary vertex detectors, which are clearly needed to take advantage of SLC's uniquely small beam interaction region. Results from the IMB(H) proton decay experiment at the Morton Salt Mine, although not detecting proton decay, set the best lower limit on the proton's lifetime. Similarly the Very High Energy Gamma Ray project is closely linked with DUMAND, at least in principle, since these gammas are expected to arise from pi-zero decay, while the neutrinos come from charged meson decay. Preparations for upgrading the Fermilab 15' Bubble Chamber have made substantial progress. Sections of the Progress Report are devoted to VAX computer system improvements, other hardware and software improvements, travel in support of physics experiments, publications and other public reports, and analysis of data still being gleaned from experimental data previously taken.

29592 (INIS-mf—8157, pp 1-8) **Preliminary results on νsub(μ)+e^-→νsub(μ)+e^-.** Baker, N.J.; Connoly, P.L.; Kahn, S.A. (Brookhaven National Lab., Upton, NY (USA)) (and others). 1982. NTIS (US Sales Only), PC A15/MF A01. Order Number DE83781040. (CONF-820675—Vol.2). TI83781040

From International conference on neutrino physics; Balaton, Hungary (14 Jun 1982).

The preliminary results on a recent experiment on νsub(μ)-e^- elastic scattering are presented. A brief review of the Glashow-Salam-Weinberg theory is given, indicating how the measurement of the total cross-section gives rise to an ambiguous solution for sin^{2}THETAsub(w), and showing how the differential cross-section can be used to resolve the ambiguity. The experimental configuration and the extraction of the signal are described. The data are compared with those from a previous experiment, and relevant dis-

tributions from the combined data sample are presented. The differential cross-section is examined in an attempt to resolve the ambiguity in sin²THETAsub(w), the lower value of sin²THETAsub(w)=0.20 being favored.

29593 (INIS-mf—8157, pp 20-29) **Measurement of the ratio sigma(νsub(μ)e→νsub(μ)e)/sigma(anti νsub(μ)e→anti νsub(μ)e).** 1982. NTIS (US Sales Only), PC A15/MF A01. Order Number DE83781040. (CONF-820675—Vol.2). TI83781040

From International conference on neutrino physics; Balaton, Hungary (14 Jun 1982).

Results of the measurement of the ratio of muon neutrino-electron to antineutrino-electron cross-sections are presented. The measured ratio, based on a sample of 46+-12 neutrino events and 77+-19 antineutrino events, is 1.37sub(-0.44)sup(+0.65). It corresponds to a value of sin²THETAsub(w)=0.215+-0.040. The systematic error in sin²THETAsub(w) is estimated to be 7%.

29594 (INIS-mf—8157, pp 51-57) **Measurement of the neutral-to-charged current cross-section ratios for νsub(μ)-interactions on proton and neutron.** 1982. NTIS (US Sales Only), PC A15/MF A01. Order Number DE83781040. (CONF-820675—Vol.2). TI83781040

From International conference on neutrino physics; Balaton, Hungary (14 Jun 1982).

In an exposure of the bubble chamber BEBC, filled with deuterium, to the CERN SPS wideband neutrino beam the neutral to charged current cross-section ratios on proton, neutron and deuteriuum has been measured. The values found are: Rsup(P)=0.478+-0.033 (stat) +-0.030 (syst); Rsup(n)=0.262+-0.017 (stat)N+-0.020 (syst); Rsup(N)=0.335+-0.016 (stat)+-0.020 (syst). The resulting values for the neutral current chiral coupling constants are: usub(L)sup(2)=0.14+-0.04 and dsub(L)sup(2)=0.18+-0.05. In the Weinberg-Salam model this corresponds to sinsup(2)THETAsub(w)=0.21+-0.03. (author).

29595 (INIS-mf—8157, pp 62-88) **Structure of electroweak interactions.** Niebergall, F. (European Organization for Nuclear Research, Geneva (Switzerland); Hamburg Univ. (Germany, F.R.). 2. Inst. fuer Experimentalphysik). 1982. NTIS (US Sales Only), PC A15/MF A01. Order Number DE83781040. (CONF-820675—Vol.2). TI83781040

From International conference on neutrino physics; Balaton, Hungary (14 Jun 1982).

The present experimental status of Weinberg-Salam model of electroweak interactions is reviewed. All experimental data are in agreement with the standard SU(2)xU(1) form of the theory. The main features of the theory and the corresponding experimental results confirming the hypotheses of the theory are listed and illustrated. The multiplet structure and universal coupling properties of the theory are discussed. The crucial test of WS theory, the discovery of W and Z bosons, is expected in 1983.

29596 **(INIS-mf—8343) Measurement of the nucleon structure function in the deep inelastic neutrino-iron scattering with a wide-band neutrino beam.** Flottmann, T. (Heidelberg Univ. (Germany, F.R.). Naturwissenschaftlich-Mathematische Gesamtfakultaet). 1982. 53p. (In German). NTIS (US Sales Only), PC A04/MF A01. Order Number DE84780168.

In this thesis the nucleon structure function xF_3 is determined from the inclusive measurement of the deep inelastic neutrino nucleon charged current interaction. The data were taken in the CERN wide band neutrino beam using the detector of the CERN-Dortmund-Heidelberg-Saclay collaboration. This detector serves at the same time as target, as hadron energy calorimeter and as muon spectrometer. One major aspect of this work was to study the possibility of using high statistics wide band beam data for structure function analysis. The systematic errors specific to this kind of beam are investigated. To obtain the differential cross sections about 100000 neutrino and 75000 antineutrino events in the energy range 20-200 GeV are analysed. The differential cross sections are normalized to the total cross sections, as measured in the narrow band beam by the same collaboration. The calculated structure function xF_3 shows significant deviations from scaling. These scaling violations are compared quantitatively with the predictions of quantum chromodynamics.

29597 (INIS-mf—8921, pp 41) **(e,e′π) reaction in light nuclei and spin-isospin strength distribution effects.** Cohen, J.; Eisenberg, J.M. (Tel Aviv Univ. (Israel). Dept. of Physics and Astronomy). 1983. NTIS (US Sales Only), PC A05/MF A01. Order Number DE84780235. (CONF-8303128—Summ.). TI84780235

From Israel Physical Society annual meeting; Ramat-Gan, Israel (24 Mar 1983).

29598 (INIS-mf—8921, pp 42) **(π,2π) reaction and spin-isospin strength distribution in T=0 nuclei.** Cohen, J.; Eisenberg, J.M. (Tel Aviv Univ. (Israel). Dept. of Physics and Astronomy). 1983. NTIS (US Sales Only), PC A05/MF A01. Order Number DE84780235. (CONF-8303128—Summ.). TI84780235

From Israel Physical Society annual meeting; Ramat-Gan, Israel (24 Mar 1983).

29599 (INIS-SU—198, pp 278) **Photoproduction on electron of neutrino-antineutrino pairs with unequal to zero of the rest mass.** Gnedov, Yu.A.; Romanov, Yu.I. 1983. (In Russian). NTIS (US Sales Only), PC A99/MF A01. Order Number DE84780104. (CONF-8304144—Summs.). TI84780104

From 23. conference on nuclear spectroscopy and nuclear structure; Moscow, USSR (19 Apr 1983).

29600 (INIS-SU—198, pp 239) **Phenomenological Σ -N potential.** Kolesnikov, N.N.; Zakharov, P.P.; Kopylov, V.A.; Tarasov, V.I. 1983. (In Russian). NTIS (US Sales Only), PC A99/MF A01. Order Number DE84780104. (CONF-8304144—Summs.). TI84780104

From 23. conference on nuclear spectroscopy and nuclear structure; Moscow, USSR (19 Apr 1983).

29601 (INIS-SU—198, pp 242) **Weak-coupled hypernuclear systems.** Kolesnikov, N.N.; Kopylov, V.A. 1983. (In Russian). NTIS (US Sales Only), PC A99/MF A01. Order Number DE84780104. (CONF-8304144—Summs.). TI84780104

From 23. conference on nuclear spectroscopy and nuclear structure; Moscow, USSR (19 Apr 1983).

29602 (INIS-SU—198, pp 268) **Space-odd spin effects in e^+e^- pair photoproduction with account for nucleus excitation.** Kerimov, B.K.; Ganiev, A.G.; Eh'gaVkhari, A.I.; Safin, M.Ya. 1983. (In Russian). NTIS (US Sales Only), PC A99/MF A01. Order Number DE84780104. (CONF-8304144—Summs.). TI84780104

From 23. conference on nuclear spectroscopy and nuclear structure; Moscow, USSR (19 Apr 1983).

29603 (JINR-R—1,2,13-83-81, pp 120-137) **Multimuon events in νsub(μ)(anti νsub(μ))N interactions and detection of dimuon events in a neutrino detector.** Ivanov, Yu.P.; Rozhdestvenskij, A.M. 1983. (In Russian). NTIS (US Sales Only), PC A08/MF A01. Order Number DE84780157. (CONF-820192—). TI84780157

From 3. working conference on IPHE-JINR neutrino detector; Dubna, USSR (18 Jan 1982).

Multimuon events in νsub(μ) (anti νsub(μ))N interactions are studied. A process of different sign dimuon production in the νsub(μ)(anti νsub(μ))N→μsup(-)πsup(+)X reaction is considered. The main contribution into a dimuon event is given by charm quark production process, its fragmentation into a charm hadron and semi-lepton decay of the charm hadron. Trimuon production in νsub(μ)N→μsup(-)μsup(-)α− sup(+)X, anti νsub(μ)N→μsup(+)μsup(+)μsup(-)N reactions is considered in the frames of the radiation and hadron models. Dimuon events with muons of the same sign (νsub(μ)N → $\mu^-\mu^-$X, anti νsub(μ)N → $\mu^+\mu^+$X) pass with production of a quarks anti c-pair and successive decay of one of the quarks through the semi-lepton channel. A possibility to

detect dimuon events in a neutrino detector is studied. The efficiency of $\mu^-\mu^+$ muon pair detection at high background radiation level is 53 %.

29604 **(JINR-R—1-83-306) Study on the inclusive charged particle characteristics in jets in πp p interactions at 40 GeV/c.** Grishin, V.G.; Didenko, L.A.; Kanarek, T.; Metreveli, Z.V. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy). 1983. 9p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE84701689.

The inclusive single particle distributions of secondary particles in jets in π^-p-interactions at 40 GeV/c are investigated. The obtained results are compared with the data on e^+e^--annihilation. The average jet charge for forward and background directions in c. m. s. is determined. The secondary particle rapidity correlations are studied with respect to the jet axis. The similarity between the inclusive single particle distributions in Feynman variable and particle rapidity from e^+e^--collisions in forward hemisphere and the same distributions from π^-p-collisions. The average jet charge for both hemispheres is consistent with the expected values for independent valence quark (diquark) fragmentation.

29605 **(KFK—3610) Investigation of tau pair production at PETRA.** Kuester, H. (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Inst. fuer Kernphysik). Nov 1983. 90p. NTIS (US Sales Only), PC A05/MF A01. Order Number DE84751303.

The reaction e^+e^- -> tau$^+$ tau$^-$ has been measured at center of mass energies around 34 GeV. The selection is sensitive to 93% of the tau pair decays, thus making possible a high identification efficiency of proportional 70% over a large solid angle. The total cross section has been measured to Rsub(tau) = sigmasub(tautau)/ sigmasub(point) = .94 +- .06(stat.) +- .06(syst.). In the differential cross section a charge asymmetry of Asub(tau) = (-(9.0 +- 6.6)% was observed, corresponding to a tau axial vector coupling to the weak neutral current of asub(tau) = -.94 +- 0.69. Moreover, final states from the decays tau -> $\pi\nu$, tau -> e$\nu\nu$, and tau -> $\mu\nu\nu$ have been isolated and branching ratios into these channels have been determined. From the inclusive momentum spectra of the observed decay products (including the channel tau -> rhoν) the forward backward asymmetry of tau polarization has been determined to Asub(p,tau) = -(1 +- 22)% which corresponds to vsub(tau) = -.1 +- 2.9. Tests on factorization are discussed.

29606 **(LA-UR—84-1327) Rare muon decays and lepton-family number conservation.** Hoffman, C.M. (Los Alamos National Lab., NM (USA)). Apr 1984. Contract W-7405-ENG-36. 30p. (CONF-840379—1). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE84011410.

From 4. course on fundamental interactions in low energy systems; Erice, Italy (31 Mar 1984).

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A brief historical survey of the discovery of the muon, interest in neutrinoless processes, and lepton-number conservation laws is given. The present view of lepton-number conservation laws and the search for $\mu \to e\gamma$ are described. Other experiments are discussed including $\mu^+ \to e^+e^+e^-$ decay, $\mu^-Z \to e^-Z$ reactions, $\mu \to e\,\gamma\gamma$ decay, other rare muon processes, strangeness-changing muon-number-nonconserving decays, and tau decays. 52 references. (WHK)

29607 (LBL—16281, pp 373-384) **$\alpha\alpha$ and αp interactions at the CERN ISR.** Stenlund, E. (CERN, Geneva, Switzerland). Dec 1983. NTIS, PC A99/MF A01. Order Number DE84005862. (CONF-830675—). TI84005862

From 6. high energy heavy ion study and 2. workshop on anomalons; Berkeley, CA, USA (28 Jun 1983).

Recent results on two-particle rapidity correlations measured in $\alpha\alpha$, αp and pp interactions are presented. The experiment was done at the CERN ISR using the Split Field Magnet detector. The true two-particle correlations were isolated by fixing the charged multiplicity. In the framework of a simple cluster model, the cluster widths as well as the cluster multiplicities were found to be the same for $\alpha\alpha$, αp and pp interactions. 9 references.

29608 (LBL—16281, pp 523-562) **Normalons, anomalons and anomalies in high energy cosmic rays.** Dar, A. (McGill Univ., Montreal, Canada). Dec 1983. NTIS, PC A99/MF A01. Order Number DE84005862. (CONF-830675—). TI84005862

From 6. high energy heavy ion study and 2. workshop on anomalons; Berkeley, CA, USA (28 Jun 1983).

We summarize the major anomalies that were reported by cosmic ray experiments and discuss possible origins of some of these anomalies. 57 references.

29609 **(SLAC-PUB—3310) New particles and interactions.** Gilman, F.J.; Grannis, P.D. (Stanford Linear Accelerator Center, CA (USA); State Univ. of New York, Stony Brook (USA); Fermi National Accelerator Lab., Batavia, IL (USA)). Apr 1984. Contract AC03-76SF00515. 20p. (CONF-840275—2). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE84010566.

From Workshop on anti pp options for the SSC; Chicago, IL, USA (13 Feb 1984).

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The Working Group on New Particles and Interactions met as a whole at the beginning and at the end of the Workshop. However, much of what was accomplished was done in five subgroups. These were devoted to: (1) new quarks and leptons; (2) technicolor; (3) supersymmetry; (4) rare decays and CP; and (5) substructure of quarks and leptons. Other aspects of new particles, e.g., Higgs, W', Z', fell to the Electroweak Working Group to consider. The central question of this Workshop of comparing anti pp (with L = 10^{32}/cm^2-sec) with pp (with L = 10^{33}/cm^2-sec) colliders carried through to all these subgroups. In addition there were several other aspects of hadron colliders which were considered: what does an increase in $\sqrt{s}$ gain in cross section and resultant sensitivity to new physics versus an increase in luminosity; will polarized beams or the use of asymmetries be essential in finding new interactions; where and at what level do rate limitations due to triggering or detection systems play a role; and how and where will the detection of particles with short, but detectable, lifetimes be important. 25 references.

29610 **(SLAC-PUB—3321) Recent results on prompt electron production at PEP.** Elsen, E. (Stanford Linear Accelerator Center, CA (USA)). Apr 1984. Contract AC03-76SF00515;AC03-81ER40050. 9p. (CONF-8403121—1). NTIS, PC A02/MF A01; GPO Dep. Order Number DE84011859.

From New particle production at high energy meeting: The Recontre de Moriond; La Plagne, France (4 Mar 1984).

Recent experimental results on production of prompt electrons in e^+e^- annihilation at PEP are reviewed. The semielectronic branching ratios and the fragmentation functions of B- and C-mesons are discussed.

29611 **(SLAC-PUB—3325) Radiative decays of the upsilon (2S) resonance.** Irion, J. (Harvard Univ., Cambridge, MA (USA). Dept. of Physics; Stanford Linear Accelerator Center, CA (USA)). Apr 1984. Contract AC03-76SF00515;AC02-76ER03064. 11p. (CONF-8403121—2). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE84011858.

From New particle production at high energy meeting: The Recontre de Moriond; La Plagne, France (4 Mar 1984).

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The Crystal Ball Detector at DORIS II was used to study radiative decays of the upsilon (2S) resonance with more than twice the previously available data. The inclusive photon spectrum of hadronic upsilon (2S) decays and the exclusive channel upsilon (2S) $\to \gamma\gamma$ upsilon (1S) $\to \gamma\gamma\, l^+l^-$ were analyzed. In the inclusive spectrum three significant photon lines at energies of $E\gamma_1$ = (108.2 +- 0.7 +- 4) MeV, $E\gamma_2$ = (127.1 +- 0.8 +- 4) MeV and $E\gamma_3$ = (160.0 +- 2.4 +- 4) MeV with branching fractions of (6.0 +- 0.7 +- 0.9)%, (6.6 +- 0.8 +- 1.0)%, (2.6 +- 0.7 +- 0.8)% respectively were measured. The lines are consistent with being transitions from the upsilon (2S) to the $^3P_2$, $^3P_1$ and $^3P_0$ states. In addition a line at

Eγ ~ 427 MeV was observed which is interpreted as transitions from the $^3P_{2,1}$ states to the upsilon (1S). 17 references.

29612 **Evidence for the electromagnetic production of the A_1.** Zielinski, M.; Berg, D.; Chandlee, C.; Cihangir, S.; Ferbel, R.; Huston, J.; Jensen, T.; Lobkowicz, F.; Ohshima, T.; Slattery, P. (University of Rochester, Rochester, New York 14627). *Physical Review Letters;* **52**: No. 14, 1195-1198(2 Apr 1984).

Using data on the coherent production of $\pi^+\pi^+\pi^-$ systems in π^+ collisions with nuclei, we have extracted an estimate for the radiative partial width of the A_1. The rate for $A_1^+ \rightarrow \pi^+\gamma$ is 640 +- 246 keV, which is a factor of about 2—3 below the value expected on the basis of predictions from quark models and from vector dominance ideas.

29613 **Search for narrow μ(π(mass enhancements in a neutrino bubble-chamber experiment.** Ballagh, H.C.; Bingham, H.H.; Lawry, T.J.; Lynch, G.R.; Lys, J.; Stevenson, M.L.; Huson, F.R.; Schmidt, E.; Smart, W.; Sokoloff, M.D. (Department of Physics and Lawrence Berkeley Laboratory, University of California, Berkeley, California 94720). *Physical Review [Section] D: Particles and Fields;* **29**: No. 7, 1300-1303(1 Apr 1984).

In a Fermilab 15-foot bubble-chamber experiment, $\mu^{-+}\pi^{+-}$ mass spectra were studied in 8444 neutrino interactions and 1367 antineutrino interactions. No significant narrow mass enhancements were found. A peak near 430 MeV/c^2 was observed, but when resolution is taken into account its significance is only roughly-equal1σ and its angular distributions do not show the characteristics expected for a resonance.

29614 **Search for highly ionizing particles in e^+e^- collisions at $\sqrt{s}$ = 29 GeV.** Fryberger, D.; Coan, T.E.; Kinoshita, K.; Price, P.B. (Stanford Linear Accelerator Center, Stanford University, Stanford, California 94305). *Physical Review [Section] D: Particles and Fields;* **29**: No. 7, 1524-1526(1 Apr 1984). Contract AC03-76SF00515.

The results of the analysis of data taken in the continuation of a previously reported search for highly ionizing particles at PEP are presented. Assemblies consisting of Lexan and CR-39 plastic track detectors were exposed in two runs to integrated luminosities of 30 x 10^{36} cm^{-2} and 150 x 10^{36} cm^{-2}. The search was sensitive to particles with magnetic charge 20e< or =g< or =200e or electric charge 3< or =Z< or =180. A combined (95% C.L.) upper limit on the production cross section of σ<3.2 x 10^{-33} cm^2 is obtained, improving our previous limits by more than an order of magnitude.

29615 **Limit on the b→u coupling from semileptonic B decay.** Chen, A.; Goldberg, M.; Horwitz, N.; Jawahery, A.; Lipari, P.; Moneti, G.C.; Trahern, C.G.; van Hecke, H.; Alam, M.S.; Csorna, S.E. (Syracuse University, Syracuse, New York 13210). *Physical Review Letters;* **52**: No. 13, 1084-1088(26 Mar 1984).

We have used the momentum spectrum of leptons produced in semileptonic B-meson decays to set a 90%-confidence-level upper limit on Γ(b→ulν)/Γ(b→clν) of 4%. We also measure the semileptonic branching fractions of the B meson to be (12.0 +- 0.7 +- 0.5)% for electrons and (10.8 +- 0.6 +- 1.0)% for muons.

29616 **Search for nucleon decay into μiK^0 and νK^0.** Cortez, B.G.; Bionta, R.M.; Blewitt, G.; Bratton, C.B.; Errede, S.; Foster, G.W.; Gajewski, W.; Ganezer, K.S.; Goldhaber, M.; Haines, T.J. (The University of California at Irvine, Irvine, California 92717; The University of Michigan, Ann Arbor, Michigan 48109; Brookhaven National Laboratory, Upton, New York 11973; California Institute of Technology, Pasadena, California 91125; Cleveland State University, Cleveland, Ohio 44115). *Physical Review Letters;* **52**: No. 13, 1092-1095(26 Mar 1984).

Observations have been made 1570 m (water equivalent) underground with an 8000 metric ton water Cherenkov detector. During a live time of 132 days, events consistent with the decay modes p→μ^+K^0 and n→νK^0 were searched for in a fiducial mass of 3300 metric tons. It is concluded that the limit on the lifetime for bound plus free protons divided by the μ^+K^0 branching ratio is tau/B>2.6 x 10^{31} yr. For bound neutrons decaying into νK^0 the limit is tau/B>0.8 x 10^{31} yr (90% confidence level).

29617 **Evidence for neutrino- and antineutrino-induced coherent π0 production.** Isiksal, E.; Rein, D.; Morfin, J.G. (III. Physikalisches Institut der Rheinisch-Westfalischen Technischen Hochschule, Aachen, West Germany). *Physical Review Letters;* **52**: No. 13, 1096-1099(26 Mar 1984).

The angular distribution of isolated photon conversion pairs, collected during the proton-synchrotron—Gargamelle ν and nu-bar freon experiments, has been examined to determine whether any anomalous small-angle production is present. There is a definite excess of conversion pairs over what is expected from resonantly produced and neutron-induced π^0's. This excess is in accord with ν- (nu-bar) induced coherent π^0 production off nuclei.

29618 **Inelastic and elastic photoproduction of J/psi(3097).** Denby, B.H.; Bharadwaj, V.K.; Summers, D.J.; Eisner, A.M.; Kennett, R.G.; Lu, A.; Morrison, R.J.; Witherell, M.S.; Yellin, S.J.; Estabrooks, P. (University of California, Santa Barbara, California 93106). *Physical Review Letters;* **52**: No. 10, 795-798(5 Mar 1984).

Inelastic and elastic J/psi photoproduction on hydrogen are investigated at a mean energy of 105 GeV. The inelastic cross section with E/sub psi/ /E/sub γ/<0.9 is significantly lower than the corresponding result for muoproduction on iron targets, but is consistent with a second-order perturbative QCD calculation.

29619 **Observation of radiative decays of the Υ(2S).** Haas, P.; Jensen, T.; Kagan, H.; Kass, R.; Behrends, S.; Chadwick, K.; Chauveau, J.; Gentile, T.; Guida, J.M.; Guida, J.A. (Ohio State University, Columbus, Ohio 43210). *Physical Review Letters;* **52**: No. 10, 799-803(5 Mar 1984).

Evidence is reported from the CLEO detector for the chi/sub b/(1P) states from radiative decays of the Υ(2S). Photons are detected by pair conversion in the beam pipe or a lead radiator, and the pair momenta are measured in the drift chamber. Two photon lines are well resolved, with energies 109.5 +- 0.7 +- 1 and 129.0 +- 0.8 +- 1 MeV.

29620 **Search for admixtures of massive neutrinos in the decay πi→μ^+ +nu-bar.** Minehart, R.C.; Ziock, K.O.H.; Marshall, R.; Stephens, W.A.; Daum, M.; Jost, B.; Kettle, P. (Physics Department, University of Virginia, Charlottesville, Virginia 22901). *Physical Review Letters;* **52**: No. 10, 804-807(5 Mar 1984).

Positive pions were stopped in a Ge detector and the energy of their decay muons was measured with a resolution of 6.7 keV. The energy spectrum was analyzed to obtain an upper limit for the branching ratio for the decay into a muon and a heavy neutrino. For neutrino masses between 2.5 and 10 MeV/c^2 this upper limit is a few parts in 10^4.

29621 **Measurement of the p-p elastic-scattering spin parameter C/sub L/L at 11.75 GeV/c for θ/sub c.m./ = 48°—90°.** Auer, I.P.; Colton, E.; Ditzler, W.R.; Hill, D.; Spinka, H.; Tamura, N.; Tavernier, J.; Theodosiou, G.; Toshioka, K.; Underwood, D. (High Energy Physics Division, Argonne National Laboratory, Argonne, Illinois 60439). *Physical Review Letters;* **52**: No. 10, 808-810(5 Mar 1984).

Results are presented of a measurement of the proton-proton elastic-scattering spin parameter C/sub L/L = (L,L;0,0) at 11.75 GeV/c and θ/sub c.m./ = 48°—90°. The value of C/sub L/L is nearly constant and is approximately -0.16 in this angular region. This behavior is consistent with only one of the many models proposed describing the interaction via the hard scattering of two quarks.

29622 **Study of the reaction πp p -> $\pi^+\pi^-$n at 100 and 175 GeV/c.** Bromberg, C.; Dickey, J.O.; Fox, G.C.; Gomez, R.; Kropac, W.; Pine, J.; Stampke, S.R. (California Inst. of Tech., Pasadena); Haggerty, H.; Malamud, E. (Fermi National Accelerator Lab., Batavia, IL); Abrams, R. *Nuclear Physics [Section] B;* **232**: No. 2, 189-235(6 Feb 1984).

The reaction $\pi^- p \rightarrow \pi^+\pi^- n$ was studied at 100 and 175 GeV/c incident beam momenta. The p^0 region cross section was 0.934 μb at 100 GeV/c and 0.229 μb at 175 GeV/c. Spherical harmonic moments in the Gottfried-Jackson frame are presented as a function of mass and proton-neutron four-momentum transfer. The pion Regge trajectory is calculated. Decay distributions are presented for the p in the helicity and Gottfried-Jackson frames. The apparatus and analysis are discussed.

29623 **Neutrino physics at Fermilab.** Jovanovic, D. (Fermi National Accelerator Laboratory, Batavia, IL). pp 373-408 of The unity of the fundamental interactions. Zichichi, A. New York, NY; Plenum Publishing Corp. (1983). (CONF-810762—).

From 19. international school of subnuclear physics; Erice, Italy (31 Jul 1981).

This chapter reports the preliminary results of 3 recently completed experiments and gives a progress report on the Fermilab experiment still in the data acquisition stage. The experiments consisted of 1) the measurement of charmed particle lifetimes, 2) the measurement of total neutrino and antineutrino cross sections, and 3) some new limits on neutrino oscillations. Points out that the 3 experiments represented different experimental techniques: emulsions, counter-detectors and bubble chambers. Notes that an overlap exists in the 3 experiments in the domain of neutrino masses and neutrino mixing. Presents a discussion featuring Jovanovich, Witten, Herten and others.

6452 Particle Interactions And Properties - Theoretical

REFER ALSO TO CITATION(S) 29590, 29679, 29682

29624 **(DESY—83-109) Quantitative non-Monte Carlo methods for low-energy QCD.** Muenster, G. (Deutsches Elektronen-Synchrotron (DESY), Hamburg (Germany, F.R.)). Oct 1983. 20p. (CONF-8308153—2). NTIS (US Sales Only), PC A02/MF A01. Order Number DE84751335.

From 7. international conference on mathemitical physics; Boulder, CO, USA (1 Aug 1983).

Strong coupling and weak coupling expansions for the low-lying mass spectrum in pure gauge theories are reviewed.

29625 **(DESY—83-118) Electroweak radiative corrections to the $^+e^-e \rightarrow {}^+\mu^-\mu$ asymmetry.** Boehm, M.; Hollik, W. (Deutsches Elektronen-Synchrotron (DESY), Hamburg (Germany, F.R.)). Nov 1983. 9p. NTIS (US Sales Only), PC A05/MF A01. Order Number DE84751348.

The electromagnetic and purely weak 1-loop corrections to $e^+e^- \rightarrow \mu^+\mu^-$ have been calculated in the SU(2)xU(1) standard model using a on-shell renormalisation scheme with finite Green functions. Their influence on the forward backward asymmetry Asub(FB) together with soft and hard bremsstrahlung is discussed for PETRA-energies. Whereas the electromagnetic corrections to γ and Z^0 exchange diminuish Asub(FB), the weak corrections increase Asub(FB) almost compensating the QED correction to Z^0 exchange. The main weak contribution comes from the Z^0 self energy. The other diagrams give only small changes in Asub(FB).

29626 (DESY-HERA—83/20, pp 39-54) **Lepton-nucleon collisions.** Perkins, D.H. Oct 1983. NTIS (US Sales Only), PC A24/MF A01. Order Number DE84751338. (CONF-8306156—). TI84751338

From Workshop on experimentation at HERA; Amsterdam, Netherlands (9 Jun 1983).

The author discusses the physics which can be studied by HERA. This concerns measurement of the hadron structure, studies of electroweak interactions at high energies, high energy photon physics, and the study of exotic phenomena. In this connection the identification of events at HERA is discussed.

29627 **(DOE/ER/02271—107) Theoretical high energy physics. Progress report, May 1, 1983-April 30, 1984.** Lee, T.D. (Columbia Univ., New York (USA). Dept. of Physics). May 1984. Contract AC02-76ER02271. 22p. (COO—2271-107). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE84011854.

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Research is described on lattice gauge theory, in particular the design and construction of an array of special purpose processors for carrying out large scale Monte Carlo simulations of lattice QCD. Two prototype processors have been constructed and their design optimized for the gauge theory calculations of interest. The detailed study of the pure SU(3) specific heat in the transition region between the strong and weak coupling limits using their original matrix multiplier and a PDP 11/34 is described. Results, based on 100,000 sweeps on a 6^4 lattice, show no increase in height of the sharp peak found a year ago for a 4^4 lattice. This indicates that this structure does not correspond to a higher order phase transition. Also, progress is reported on a thesis project: a Monte Carlo study of the Abbott-Farhi model. This is a strong-coupling model of the standard Weinberg-Salam weak interaction theory whose properties can at present only be determined using numerical lattice gauge theory methods. An improved version of the matrix multiplier was completed, and the programs required to connect it to the VAX for use in QCD calculations on a random lattice are under development. Progress on the study of the problem of baryon number violation in the presence of SU(5) 't Hooft-Polyakov magnetic monopoles is described. A very simple model has been developed which appears to contain the essential features of this problem and which may allow a systematic solution. Publications are listed. (WHK)

29628 **(DOE/ER/03992—552) Research program in elementary particle theory. Progress report, 1984.** Sudarshan, E.C.G.; Dicus, D.A. (Texas Univ., Austin (USA). Center for Particle Theory). Apr 1984. Contract AS05-76ER03992. 79p. NTIS, PC A05/MF A01; GPO Dep. Order Number DE84011502.

Research progress is reported on the following topics: gauge theory and monopole physics; supersymmetry and proton decay; strong interactions and model of particles; quantum rotator and spectrum generating group models of particles; geometric foundations of particle physics and optics; and application of particle physics to astrophysics. The titles of DOE reports are listed, and research histories of the scientific staff of the Center for Particle Theory are included. (WHK)

29629 **(DOE/ER/40108—1) Unusual initial and final state effects in quantum chromodynamics. Progress report.** Nelson, C.A. (State Univ. of New York, Binghamton (USA). Dept. of Physics). Mar 1984. Contract AC02-83ER40108. 6p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE84010422.

Portions are illegible in microfiche products.

Unlike for only soft initial degenerate states, the KLN theorem suggests that there will at least be a singular, if not a finite, contribution to the non-singlet structure function arising from initial collinear and soft degenerate states. We have extended the notion of double cut diagrams so as to evaluate the contribution from these states to the operator matrix elements and thereby are able to use the renormalization group equation in extracting the non-singlet coefficient function. This provides an alternative approach to the factorization of mass singularities and introduces in a practical context a degenerate state concept for the basic partons. In two preprints, the θ θ parity test is generalized to any specific $X \rightarrow V_1V_2$ decay mode where the vector mesons V_1 and V_2 each decays into two spin zero bosons. From a strong V_1V_2 mode with a $V_1 \rightleftharpoons V_2$ exchange property, the parity eta of X can always be determined. For weak VV or V anti V channels, the CP eigenvalue of the decaying X can be determined which means that a Higgs boson can be simply distinguished from a technipion. A sin2 phi or sin phi term in the azimuthal angular distribution would imply that CP is violated.

29630 **(EFI—593(80)-82) Hadrons from relativistic quarks and spin effects in high-energy processes at high Q^2.** Esaybegyan, S.V.; Grigoryan, S.G.; Ter-Isaakyan, N.L. (Erevanskij Fizicheskij Inst. (USSR)). 1982. 16p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE84701682.

Polarization effects in inclusive and exclusive large-angle processes are analyzed within the framework of the relativistic

quark model. The consequences of the H spin invariance violation when considering quark-exchange and Landshoff diagrams in elastic nucleon-nucleon scattering are considered. It is shown that spin-flip amplitudes are not equal to zero because of the presence in relativistic wave functions of terms violating helicity conservation in the hadron-quark transition vertices.

29631 **(IC—82/218) Gyroelectric ratio of supersymmetrical monopole determined by its structure.** Hou, Bo-Yu. (International Centre for Theoretical Physics, Trieste (Italy)). Dec 1982. 12p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE84701684.

This paper analyzes the distribution of the electric dipole produced by the zero energy charged particle around a Dirac monopole and then finds the unbroken U(1) electric polarization inherent by the supersymmetric monopole field so one can obtain its gyroelectric ratio as an intrinsic property.

29632 (INIS-mf—8921, pp 87) **Hyperleptonic generations in unifying schemes.** Davidson, A.; Sonnenschein, J. (Weizmann Inst. of Science, Rehovoth (Israel). Dept. of Nuclear Physics). 1983. NTIS (US Sales Only), PC A05/MF A01. Order Number DE84780235. (CONF-8303128—Summ.). TI84780235

From Israel Physical Society annual meeting; Ramat-Gan, Israel (24 Mar 1983).

29633 **(JINR-R—2-83-83) Magnetostriction of a quark bag and hadron polarizability.** Matveev, V.A.; ChizhoV, A.V. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1983. 6p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE84701683.

One of possible mechanisms of generating the hadron magnetic polarizability is pointed out. It is connected with nonperturbative effects in quantum chromodynamics. Introduction of an external magnetic field causes a change of the quark bag volume (shape). This magnetostriction effect of the quark bag leads to a dependence of its volume energy on the strength of the field and provides an additional contribution to the hadron polarizability. Estimates of the corresponding contributions for the proton, neutron and charged pion are 4.4×10^{-5} Fm^3, 2.1×10^{-5} Fm^3 and 2.5×10^{-5} Fm^3. Estimates presented for the pion as well as for the nucleon are by an order less than the experimental values of their polarizabilities. Thus the magnetostriction effect of the bound quark system in an external field is not excluded by experiments.

29634 **"Six-quark" component in the deuteron from a comparison of electron and neutrino/antineutrino structure functions.** Mulders, P.J.; Thomas, A.W. (Center for Theoretical Physics, Laboratory for Nuclear Science and Department of Physics, Massachusetts Institute of Technology, Cambridge, Massachusetts 02139). *Physical Review Letters;* **52**: No. 14, 1199-1202(2 Apr 1984). Contract AC02-76ER03069.

We discuss a way to measure the "six-quark" component in the deuteron from a comparison of the structure functions in ep and ed deep-inelastic scattering and the structure functions in νp and nu-barp scattering. Such a determination is obtained by looking at the deviation from 1 in the ratio $T = d(x)u(x)/u(x)d(x)$, where u and d are the quark distributions determined from νp and nu-barp, and u and d are the effective quark distributions determined from ep and ed by neglect of coherent six-quark effects.

29635 **Composite models and finite-width effects on $e^+e^- \rightarrow \mu^+\mu^-$ asymmetry.** Chen, P.; Rek, Z.; Renard, F.M. (Department of Physics, University of California, Los Angeles, California 90024). *Physical Review* [*Section*] *D: Particles and Fields;* **29**: No. 7, 1309-1316(1 Apr 1984). Contract AC03-76SF00515.

We investigate the possibility of distinguishing the standard model from composite models at an intermediate energy range (45—60 GeV). We show that effects due to multiple neutral weak bosons and their finite widths can be observable in $e^+e^- \rightarrow \mu^+\mu^-$ forward-backward asymmetry.

29636 **Production of scalar leptons in W- and Z-boson decay.** Michael Barnett, R.; Haber, H.E.; Lackner, K.S. (Institute for Theoretical Physics, University of California, Santa Barbara, California 93106). *Physical Review* [*Section*] *D: Particles and Fields;* **29**: No. 7, 1381-1392(1 Apr 1984). Contract AC03-76SF00515.

Alternative decay modes of the W and Z bosons may provide a method either to discover the supersymmetric partners of leptons or to set greatly improved limits on their masses. Details are provided on these methods, and various distributions are shown for separating potential backgrounds. If p-barp→W→e/sub s/ν/sub s/ is allowed, a clear signal for supersymmetry could be established from future data. In e^+e^- annihilation a distinctive signature for scalar neutrinos could be jets plus an electron all confined to a single hemisphere (with substantial missing energy). Even more dramatic but rarer would be events with only $e^+ + \mu^-$ together in one hemisphere and all other energy missing.

29637 **Hadron-hadron collisions at extreme energies: Light-cone QCD with an axial-vector anomaly current and an infrared fixed point.** White, A.R. (High Energy Physics Division, Argonne National Laboratory, Argonne, Illinois 60439). *Physical Review* [*Section*] *D: Particles and Fields;* **29**: No. 7, 1435-1454(1 Apr 1984).

We argue that QCD with the maximum number of fermions allowed by asymptotic freedom provides a "parton-model" description of soft high-energy collisions. That is, infinite-momentum quantization can be based on the perturbative vacuum and yet produce confinement and chiral-symmetry breaking. A first-stage infrared construction gives SU(2) gauge invariance and confinement. An infrared fixed point produces transverse momentum scaling and associated infrared divergences which couple to an anomaly-current component of a Fock-space wave function. The divergences factor on to color-zero states allowing the wave function zeros needed by transverse gauge invariance. Parton interactions are dominated by fermion-loop anomalies coupled to the divergences. As a result a pion has a vector valence-quark component. The infrared limit giving SU(3) gauge invariance is argued to be accompanied by critical-Pomeron high-energy behavior and spontaneous chiral-symmetry breaking, but is only briefly discussed in this paper.

29638 **Production of nonstandard Higgs bosons in e^+e^- collisions p.** Deshpande, N.G.; Tata, X.; Dicus, D.A. (Institute of Theoretical Science, University of Oregon, Eugene, Oregon 97403). *Physical Review* [*Section*] *D: Particles and Fields;* **29**: No. 7, 1527-1530(1 Apr 1984).

We show that in any theory with more than one Higgs multiplet, Higgs bosons may be copiously produced in electron-positron collisions at energies around the Z pole. The production of neutral Higgs bosons substantially exceeds that of charge Higgs bosons.

29639 **Hadronic remnants in W and Z production.** Rosner, J.L. (Enrico Fermi Institute and Department of Physics, University of Chicago, Chicago, Illinois 60637). *Physical Review* [*Section*] *D: Particles and Fields;* **29**: No. 7, 1531-1532(1 Apr 1984). Contract AC02-82ER40073.

It is proposed that in p-barp→(W^{+-} or Z)+hadrons, the remaining hadrons should behave on the whole like products of e^+e^- annihilations at a squared c.m. energy $s = s(1-x_1)(1-x_2)$, where $x_1x_2 = (M/\text{sub WorZ/})^2/s$, x_1-x_2 = p/sub WorZ//p/sub beam/. This allows one to anticipate gross features of $e^+e^- \rightarrow$hadrons up to c.m. energies of $\sqrt{s}$ -M/sub W/orZ (up to 450 or 460 GeV for the present CERN collider, and up to nearly 1 TeV at the Fermilab Tevatron).

29640 **Field compensation as an alternative to magnetic shielding in searches for nn-bar transitions.** Kabir, P.; Nussinov, S.; Aharonov, Y. (Theoretical Division, Los Alamos National Laboratory, Los Alamos, New Mexico 87545). *Physical Review* [*Section*] *D: Particles and Fields;* **29**: No. 7, 1537-1538(1 Apr 1984).

Application of suitable additional intermittent magnetic fields is proposed as an alternative to magnetic shielding in searches for n-n-bar transitions. The quenching effect of the Earth's field can be

negated by assuring that, within a characteristic time interval, a neutron experiences zero field on average.

29641 **Neutrino charge in the linear R/sub xi/ gauge.** Lucio Martinez, J.L.; Rosado, A.; Zepeda, A. (Centro de Investigacion y de Estudios Avanzados del Instituto Politecnico Nacional, Apartado Postal 14-740, 07000 Mexico, Distrito Federal Mexico). *Physical Review* [*Section*] *D: Particles and Fields;* **29**: No. 7, 1539-1541(1 Apr 1984).

It is shown that in the SU(2)/sub L/ x U(1) model of electroweak interactions dimensional regularization guarantees the vanishing of the one-loop contributions to the neutrino charge for every dimension n and for every value of the gague-fixing parameter ξ without the need for counterterms and without having to invoke Ward identities.

29642 **Parity-odd asymmetries in W-jet events at hadron colliders p.** Hagiwara, K.; Hikasa, K.; Kai, N. (Physics Department, University of Wisconsin, Madison, Wisconsin 53706). *Physical Review Letters;* **52**: No. 13, 1076-1079(26 Mar 1984). Contract AC02-76ER00881.

Parity-nonconserving asymmetries appear in the angular distribution of the charged leptons from the decay of W bosons produced with high transverse momentum in hadron colliders. Absorptive parts of the amplitudes which produce the nonvanishing asymmetry are calculated in the one-loop order. The asymmetries grow rapidly with the W transverse momentum q/sub T/ and reach a 5% level at q/sub T/$\sim$20 GeV. Measurements of the sign of the asymmetries will distinguish clearly between V-A and V+A couplings without polarization experiments.

29643 **Some comments on heavy fermions and leptoquarks.** Nussinov, S. (Center for Theoretical Physics, Department of Physics and Astronomy, University of Maryland, College Park, Maryland 20742). *Physical Review Letters;* **52**: No. 12, 963-965(19 Mar 1984).

It is pointed out that if heavy [O(TeV)] fermion generations exist and if the source of their masses is the single doublet of the Glashow-Weinberg-Salam model {with a light [< or =O(1/2) TeV)] physical Higgs} then very tightly bound exotic LQ, LQ-bar, QQ, LL, etc., states may arise marking a dramatic appearance of new physics. In passing there is recalled the phenomenological observation that a discovery of a top quark via its semileptonic decay will practically exclude charged Higgs particles in the mass range m/sub t/-m/sub b/> or =M+.

29644 **Prompt electron production in e^+e^- annihilation at 29 GeV p.** Koop, D.E.; Sakuda, M.; Atwood, W.B.; Baillon, P.H.; Barish, B.C.; Bonneaud, G.R.; DeStaebler, H.; Donaldson, G.J.; Dubois, R.; Duro, M.M. (California Institute of Technology, Pasadena, California 91125 and Stanford Linear Accelerator Center and Physics Department, Stanford University, Stanford, California 94305). *Physical Review Letters;* **52**: No. 12, 970-973(19 Mar 1984). Contract AC03-76SF00515;AC03-81ER40050.

Inclusive electrons have been studied in hadronic events from e^+e^- annihilation at 29 GeV. The cross section is measured as $\sigma(e^+e^-\rightarrow e^{+-}X) = 35.8 +- 4.6$ pb in the momentum range $0.5<p<5.5$ GeV/c. The semielectronic branching ratios of b and c quarks are found to be (14.6 +- 2.8)% and (9.1 +- 1.3)%, respectively. Hard p fragmentation functions are found for both b and c, with <z/sub b/> = 0.78 +- 0.05 and <z/sub c/> = 0.69 +- 0.06. No evidence of anomalous electron production is observed.

29645 **Mass of the Higgs boson in the canonical realization of the Salam-Weinberg theory.** Beg, M.A.B.; Panagiotakopoulos, C.; Sirlin, A. (The Rockefeller University, New York, New York 10021). *Physical Review Letters;* **52**: No. 11, 883-886(12 Mar 1984). Contract AC02-81ER40033.

It is shown that, for a wide range of top-quark masses, the Higgs mass in the canonical realization of the Salam-Weinberg theory must be < or $\approx$125 GeV. The considerations are predicated on the premise that the pure λphi^4 theory is a free-field theory. The bound emerges as a necessary condition, albeit within a specific scenario, to avoid the trap of a trivial Higgs sector.

29646 **Doubly strange dibaryon in the chiral model.** Balachandran, A.P.; Barducci, A.; Lizzi, F.; Rodgers, V.G.J.; Stern, A. (Physics Department, Syracuse University, Syracuse, New York 13210). *Physical Review Letters;* **52**: No. 11, 887-890(12 Mar 1984). Contract AC02-76ER03533.

It is shown that the chiral model with SU(3) flavor symmetry predicts a dibaryon state of low mass M (Mroughly-equal2x2 GeV). It is electrically neutral and is an SU(3) singlet with J/sup P/ = 0^+. It corresponds to a six-quark state found in the MIT bag model by Jaffe. It is also shown that there is no stable particlelike state of baryon number 2 which is based on Skyrme's spherically symmetric ansatz for the chiral field.

29647 **Gluino decays and experimental signatures.** Haber, H.E. (California Univ., Santa Cruz; Stanford Linear Accelerator Center, CA); Kane, G.L. (Michigan Univ., Ann Arbor). *Nuclear Physics* [*Section*] *B;* **232**: No. 2, 333-348(6 Feb 1984).

Supersymmetry could be revealed by the discovery of gluinos, the supersymmetric partners of the gluons. Previously, it has been assumed that gluinos decay entirely into q anti q γ tilde (or gGAMMA tilde if a goldstino GAMMAtilde exists) where the photino γ tilde is assumed to be the lightest supersymmetric particle. We point out that the C-violating decay vertical strokeγ tilde -> g γ tilde could be competitive if there is sufficient mass splitting between the scalar partners of the left- and right-handed quarks. We also consider four-body gluino decay modes which under certain conditions could dominate, and we relax the usual assumption of massless photinos. We discuss the phenomenological implications of these new modes and indicate the effects on possible experimental signatures of supersymmetry; when the g γ tilde mode is large it greatly improves the possibilities for detecting gluinos in both collider and beam dump experiments, perhaps even allowing detection of individual events at colliders. 32 references.

29648 **Fine- and hyperfine structure analysis of heavy quarkonia: (banti b)- and (tanti t)-states.** Steiger, A.D. (California Univ., Livermore (USA). Lawrence Livermore National Lab.). *Physics Letters,* [*Section*] *B;* **129**: No. 5, 335-340(29 Sep 1983).

The fine- and hyperfine of (banti b)-states is analyzed in a spin-dependent one-parameter potential model. Since this model reproduces the observed masses and leptonic widths of the upsilon family with remarkable accuracy, it is used to predict properties of toponium for a recently suggested t-quark mass of 35 GeV.

29649 **Meson radiation from a quark-gluon plasma by fission of chromoelectric flux tubes.** Banerjee, B.; Glendenning, N.K.; Matsui, T. (California Univ., Berkeley (USA). Div. of Nuclear Science; Lawrence Berkely Lab., CA (USA)). *Physics Letters,* [*Section*] *B;* **127**: No. 6, 453-457(11 Aug 1983).

The chromoelectric flux tube model is used to obtain a dynamical description of the evaporation of mesons from a quark-gluon plasma. The radiation pressure is computed to assess wether this process is an important mode for the disassembly of a compressed plasma. A new result for the rate of qanti q pair creation, which is the mechanism for fission of the tube, is employed.

29650 **Status of theories of CP noninvariance.** Deshpande, N.G. (University of Oregon Eugene, OR 97403). pp 531-541 of Particles and fields. Capri, A.Z.; Kamal, A.N. New York, NY; Plenum Publishing Corp. (1983). (CONF-810882—). Contract AT06-76ER70002.

From 1981 Banff summer institute on particles and fields; Calgary, Alberta, Canada (16 Aug 1981).

This chapter reviews different gauge models of CP nonconservation. Shows that when both experimental and theoretical constraints are imposed, the Kobayashi-Maskawa model is the most acceptable theory. Discusses gauge theories of CP noninvariance; CP violation through Higgs bosons; CP phenomenology in the K-system; the difficulty with the Weinberg model; CP violation through heavy gauge bosons; and the strong CP problem. Finds that CP violation arising purely from Higgs sector or heavy gauge

boson exchange, though not completely ruled out, is rather unlikely.

29651 **Small and an invisible axion as automatic consequences of grand unification.** Hall, L.J. (Lawrence Berkeley Laboratory Berkeley, CA 94720). pp 561-569 of Particles and fields. Capri, A.Z.; Kamal, A.N. New York, NY; Plenum Publishing Corp. (1983). (CONF-810882—). Contract W-7405-ENG-48.

From 1981 Banff summer institute on particles and fields; Calgary, Alberta, Canada (16 Aug 1981).

This chapter explores the possibility of solving the strong CP problem in a grand unified theory in which a global Peccei-Quinn (PQ) symmetry is an automatic consequence of the gauge structure. Points out that the low energy effective theory differs from that of the standard model only by the presence of an extremely light, weakly interacting axion. Describes 4 models which incorporate the PQ mechanism. The simplest model has two SU(2) doublets of scalar particles, but predicts a light pseudo-Goldstone boson (PGB), the axion, which has yet to be experimentally confirmed. The second model removes such an axion, at the expense of introducing a new fine tuning problem. This is resolved by embedding the model in a grand unified theory (GUT). Gives a GUT which seeks to explain the origin of U(1)PQ. Discusses two aspects of gauge theories which are considered by many to be undesirable; namely, global symmetries and the fine tuning of parameters of the theory.

29652 **Flavor mixings and flavor unifications.** Kang, K. (Brown University Providence, RI 02912). pp 571-593 of Particles and fields. Capri, A.Z.; Kamal, A.N. New York, NY; Plenum Publishing Corp. (1983). (CONF-810882—). Contract AC02-76ER03130.

From 1981 Banff summer institute on particles and fields; Calgary, Alberta, Canada (16 Aug 1981).

This chapter discusses the problem of flavor mixing and calculability of the mixing parameters along the line of naturality group approach in the context of electroweak gauge theories. Examines flavor unification in SU(7) grand unification models. Applies the projection operator method to give eigenvalues of subgroup branches including those of U(1)'s, from which the hypercharge operators are constructed for all distinct and physically interesting modes of symmetry-breaking. Compares fermion contents in two different flavor unification schemes of SU(7). Discusses natural flavor conservation; mass matrix and mixing angles; calculability; and natural flavor conservation and calculability.

29653 **Initial state interactions, factorization, and the Drell-Yan process.** Bodwin, G.T. (S.L.A.C., Stanford University Stanford, CA 94305). pp 513-529 of Particles and fields. Capri, A.Z.; Kamal, A.N. New York, NY; Plenum Publishing Corp. (1983). (CONF-810882—).

From 1981 Banff summer institute on particles and fields; Calgary, Alberta, Canada (16 Aug 1981).

This chapter presents results of some work done in collaboration with S.J. Brodsky and G.P. Lepage in which the effects of initial state interactions in the Drell-Yan process were investigated. Discusses elastic interactions; gluon bremsstrahlung; and other processes. Predicts two important effects arising from initial state interactions in the Drell-Yan process at large Q^2. Notes that these predictions do not depend critically upon the detailed nature of the color-changing active-spectator interaction, and that they seem to be based on rather general concepts like conservation of flux (unitarity) and the uncertainty principle, which apply outside the domain of perturbation theory. Suggests that initial and final state interactions occur quite generally in inclusive hadronic processes.

6453 Particle Invariance Principles And Symmetries

REFER ALSO TO CITATION(S) 29827

29654 (INIS-mf—8921, pp 16) **Interaction of anti-nucleons with nucleons and nuclei.** Avishai, Y. (Tel Aviv Univ. (Israel). Dept. of Physics and Astronomy). 1983. NTIS (US Sales Only), PC A05/MF A01. Order Number DE84780235. (CONF-8303128—Summ.). TI84780235

From Israel Physical Society annual meeting; Ramat-Gan, Israel (24 Mar 1983).

29655 **Constraints on the interactions of Majorana particles from CPT invariance.** Khare, A.; Oliensis, J. (Fermi National Accelerator Laboratory, Batavia, Illinois 60510). *Physical Review* [*Section*] *D: Particles and Fields;* **29**: No. 7, 1542-1543(1 Apr 1984). Contract W-31-109-ENG-38.

We derive a constraint on the gravitational interaction of a Majorana particle from CPT invariance, following the work of Kayser and Goldhaber on the electromagnetic form factor. Similar constraints hold for the decay of an integer spin particle into two identical Majorana particles. Lastly we attempt to clarify the role played by CPT invariance in deriving these and the previous results.

6454 Field Theory

REFER ALSO TO CITATION(S) 29533, 29541, 29627, 29637, 29642, 29645, 29646, 29647

29656 **(BNL—34599) Grand unified theories.** Marciano, W.J. (Brookhaven National Lab., Upton, NY (USA)). 11 Sep 1983. Contract AC02-76CH00016. 16p. (CONF-8309163—5). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE84010786.

From Conference on low energy tests of conservation laws in particle physics; Blacksburg, VA, USA (12 Sep 1983).

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Topics discussed include coupling constants; minimal SU(5) predictions ($\sin^2\theta$/sub W/, m/sub W/ and m/sub Z/, proton decay, and magnetic monopoles); Higgs scalar effects including proton decay and flavor changing and oscillation phenomena; and supersymmetry. 31 references.

29657 **(BNL—34642) Numerical calculations in quantum field theories.** Rebbi, C. (Brookhaven National Lab., Upton, NY (USA)). 1984. Contract AC02-76CH00016. 39p. (CONF-840281—1). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE84010892.

From 23. Internationale Universitatswochen fur Kernphysik; Schladming, Austria (20 Feb 1984).

Portions are illegible in microfiche products.

Four lecture notes are included: (1) motivation for numerical calculations in Quantum Field Theory; (2) numerical simulation methods; (3) Monte Carlo studies of Quantum Chromo Dynamics; and (4) systems with fermions. 23 references. (WHK)

29658 **(IC—82/188) Response and normal modes of a system in the electric and magnetic-dipole approximation.** Obada, A.S.F.; Mahran, M.H. (International Centre for Theoretical Physics, Trieste (Italy)). Dec 1982. 21p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE84701667.

The effect of making the interaction fields evolve from a finite time of a system of molecules is studied in the electric- and magnetic-dipole approximation. Features due to the breaking up of the infinite evolution time are discussed. The resulting equations are analyzed for the response of the system. The analysis of the equations for the propagation of normal modes is manifested. The conditions under which normal modes propagate are stated.

29659 **(IC—82/230) Finiteness of broken N=4 super Yang-Mills theory.** Namazie, M.A.; Salam, A.; Strathdee, J. (International Centre for Theoretical Physics, Trieste (Italy)). Nov 1982. 23p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE84701668.

Using a light cone gauge formulation for N=4 extended supersymmetry, it is shown that an explicit breaking of the supersymmetry by addition of mass terms does not disturb off-shell finiteness to any order provided the sum of fermion masses equals the sum of scalar masses and appropriate cubic interactions between scalars are included.

29660 **(IC—82/234) Van der Waals-like forces in spontaneously broken supersymmetries.** Radescu, E.E. (International Centre for Theoretical Physics, Trieste (Italy)). Dec 1982. 9p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE84701669.

In spontaneously broken rigid supersymmetry, Goldstone fermion pair exchange should lead to a universal interaction between massive bodies uniquely fixed by the existing low energy theorem. The resulting van der Waals-like potential is shown to be $V(r)=Mm\pi^{-3}F^{-4}r^{-7}+O(r^{-8})$, where M,m are the masses of the interacting bodies while $\sqrt{F}$ is the scale of the breaking. The change in the situation when the supersymmetry is promoted to a local one is briefly discussed.

29661 **(IC—83/22) Sketch to the geometrical N=2-d=5 Yang-Mills theory over a supersymmetric group-manifold - I.** Borges, M.; Pio, G. (International Centre for Theoretical Physics, Trieste (Italy)). Mar 1983. 33p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE84701670.

This work concerns the search and the construction of a geometrical structure for a supersymmetric N=2-d=5 Yang-Mills theory on the group manifold. From criteria established throughout this paper, we build up an ansatz for the curvatures of our theory and then solve the Bianchi identities, whose solution is fundamental for the construction of the geometrical action.

29662 **(IC—83/36) Elementary representations and interwining operators for SU(2,2) - I.** Dobrev, V.K. (International Centre for Theoretical Physics, Trieste (Italy)). Apr 1983. 61p. NTIS (US Sales Only), PC A04/MF A01. Order Number DE84701673.

The structure of the group SU(2,2) and of its Lie algebra is studied in detail. The results will be applied in subsequent parts devoted to the explicit construction of elementary representations of SU(2,2) induced from different parabolic subgroups and of the intertwining operators between these representations. A summary of some results of Parts II and III is given.

29663 **(IC—83/42) Nelson's stochastic quantization of free linearized gravitational field and its Markovian structure.** Lim, S.C. (International Centre for Theoretical Physics, Trieste (Italy)). May 1983. 15p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE84701666.

It is shown that by applying Nelson's stochastic quantization scheme to free linearized gravitational field tensor one can associate with the resulting stochastic system a stochastic tensor field which coincides with the "space" part of the Riemannian tensor in Euclidean space-time. However, such a stochastic field fails to satisfy the Markov property. Instead, it satisfies the reflection positivity. The Markovian structure of the stochastic fields associated with the electromagnetic field is also discussed.

29664 **(IC—83/54) Hamiltonian structures of some nonlinear evolution equations.** Tu, G.Z. (International Centre for Theoretical Physics, Trieste (Italy)). Jun 1983. 23p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE84701672.

The Hamiltonian structure of the O(2,1) non-linear sigma model, generalized AKNS equations, are discussed. By reducing the O(2,1) non-linear sigma model to its Hamiltonian form some new conservation laws are derived. A new hierarchy of non-linear evolution equations is proposed and shown to be generalized Hamiltonian equations with an infinite number of conservation laws.

29665 **(INIS-BR—105) Hamiltonian formulation of QED in the superaxial gauge.** Girotti, H.O. (Rio Grande do Sul Univ., Porto Alegre (Brazil). Inst. de Fisica); Rothe, H.J. (Heidelberg Univ. (Germany, F.R.). Inst. fuer Theoretische Physik). (Rio Grande do Sul Univ., Porto Alegre (Brazil). Inst. de Fisica). 1984. 11p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE84701922.

A Hamiltonian formulation of QED in a fully fixed axial gauge is presented. The equal-time commutators for all field variables are computed and are shown to lead to the correct equations of motion. The constraints and gauge conditions hold as strong operator relations.

29666 **(INIS-mf—8921, pp 86) Complex Rishon-type unification.** Davidson, A.; Sonnenschein, J. (Weizmann Inst. of Science, Rehovoth (Israel). Dept. of Nuclear Physics). 1983. NTIS (US Sales Only), PC A05/MF A01. Order Number DE84780235. (CONF-8303128—Summ.). TI84780235

From Israel Physical Society annual meeting; Ramat-Gan, Israel (24 Mar 1983).

29667 **(INIS-mf—8921, pp 88) Do 't Hooft anomaly equations know about Georgi-Glashow grand unification.** Davidson, A.; Sonnenschein, J. (Weizmann Inst. of Science, Rehovoth (Israel). Dept. of Nuclear Physics). 1983. NTIS (US Sales Only), PC A05/MF A01. Order Number DE84780235. (CONF-8303128—Summ.). TI84780235

From Israel Physical Society annual meeting; Ramat-Gan, Israel (24 Mar 1983).

29668 **(JINR—E-2-83-301) Why different forms of the light cone expansion.** Bordag, M.; Robaschik, D.; Geyer, B. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1983. 13p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE84701648.

Different types of light-cone expansions are traced back to an operator identity proved by S. A. Anikin and O. I. Zavialov. As a new type of light-cone expansion, a nonlocal conformal one, is proposed and applied to a nonforward scattering process. It is shown that the anomalous dimensions of the corresponding light-cone operators are diagonal in one of the two parameters to all orders of perturbation theory. This leads to one-parameter evolution equations. For simplicity all considerations here are based on scalar field theory.

29669 **(JINR—E-5-83-228) Interpolation by Pade approximants.** Bogdanova, N.; Nichitiu, F. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems). 1983. 7p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE84701649.

The interpolation problem for error affected complex functions in order to best extrapolate them in the cutcomplex plane is studied. The methods used for interpolation are the diagonal and near-diagonal Pade approximants (PA) of the second type (PA2) and their modification for the chi^2 minimization (PA3). The general interpolation problem for error affected functions is formulated. Using some numerical examples, it is shown that there exists an optimum set of interpolating points. The connection between the PA3 and the PA2 for this optimum set of interpolating points is revealed. To conclude, in the interpolation problem for error affected complex functions there exists an optimum set of interpolating points which can give the best PA in the PHI^2 sense, and here a practical method for finding it is proposed.

29670 **(JINR-R—2-83-157) Electromagnetic radiation during the flight of relativistic particles through a small section of the force field.** Bonch-Osmolovski, A.G.; Lyuboshits, V.L.; Podgoretski, M.I. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy). 1983. 12p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE84701652.

The low frequency part of the spectrum of the electromagnetic radiation arising at a change of the velocity direction of an ultrarelativistic charged particle within certain section of a force field of finite length l is investigated. It is shown that the correction to the spectrum-angular density of radiation corresponding to an instantaneous change of velocity has a magnitude of an order of (l/Lsub(phi)), where Lsub(phi)=2cγsup(2)/ω(1+γsup(2)thetasup(2)) is the formation length, ω is the radiation frequency, γ is the Lorentz-factor, theta is the angle between the longitudinal velocity of a particle and the direction of radiation. An the same time the correction to the spectrum density, after integrating over angles, turns out to be proportional to the length of an intermediate interval, but not to the square of this length.

29671 **(JINR-R—11-83-329) Structure of matrices in the method of boundary integral equations for the Laplace operator.** Zhidkov, E.P.; Khoromskij, B.N. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Computing Techniques and Automation). 1983. 8p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE84701650.

The structure of matrices occuring at discretization of boundary integral equations for Laplace operator for the cases of one and two space variables is considered. It is shown that for some regions with boundaries having parallel elements the corresponding matrices have the special block structure, which allows one to decrease considerably the amount of computer necessary to store these matrices. The results may be used for accelerating the direct as well as iterative methods of solution of corresponding linear systems of algebraic equations.

29672 **(JINR-R—17-83-33) Some specific properties of scattering on solitons in the model of current-current interaction. Soliton form factor in the kinematic region of t in the range of [0,4m²] momenta.** Grishin, V.E.; Fedyanin, V.K. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1983. 13p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE84701651.

In the framework of semiphenomenological approach the structure of vertex function for "soliton current" is investigated, soliton form factor is calculated for a model with Usub(Q)(1)-symmetry. It is shown that the obtained dependence on the model relativistic invariants leads to the existence of poles in the kinematic region of q^2 in the range of (0.4 m^2) momenta. The connection is found between poles and resonance states. Each separate peak taking into account a background phase shift is a resonance of Breit-Wigner type.

29673 **(LA-UR—84-1311) Fun with supersymmetric quantum mechanics.** Freedman, B.; Cooper, F. (Illinois Univ., Urbana (USA). Dept. of Physics; Los Alamos National Lab., NM (USA)). Apr 1984. Contract W-7405-ENG-36. 21p. (CONF-831267—4). NTIS, PC A02/MF A01; GPO Dep. Order Number DE84011329.

From Workshop on supersymmetry in physics; Los Alamos, NM, USA (15 Dec 1983).

One reason for studying supersymmetric quantum mechanics is that there are a class of superpotentials W(x) which behave at large x as x/sup α/ for which we know from general arguments whether SUSY is broken or unbroken. Thus one can use these superpotentials to test various ideas about how to see if supersymmetry is broken in an arbitrary model. Recently, Witten proposed a topological invariant, the Witten index Δ which counts the number of bosons minus the number of fermions having ground state energy zero. Since if supersymmetry is broken, the ground state energy cannot be zero, one expects if Δ is not zero, SUSY is preserved and the theory is not a good candidate for a realistic model. In this study we evaluate Δ for several examples, and show some unexpected peculiarities of the Witten index for certain choice of superpotentials W(x). We also discuss two other nonperturbative methods of studying supersymmetry breakdown. One involves relating supersymmetric quantum mechanics to a stochastic classical problem and the other involves considering a discrete (but not supersymmetric) version of the theory and studying its behavior as one removes the lattice cuttoff. In this survey we review the Hamiltonian and path integral approaches to supersymmetric quantum mechanics. We then discuss the related path integrals for the Witten Index and .for stochastic processes and show how they are indications for supersymmetry breakdown. We then discuss a system where the superpotential W(x) has assymetrical values at +- ∞. We finally discuss nonperturbative strategies for studying supersymmetry breakdown based on introducing a lattice and studying the behavior of the ground state energy as the lattice cutoff is removed. 17 references.

29674 **(SLAC-PUB—3263) Applied chromodynamics.** Brodsky, S.J. (Stanford Linear Accelerator Center, CA (USA)). Nov 1983. Contract AC03-76SF00515. 34p. (CONF-8305187—2). NTIS, PC A03/MF A01; GPO Dep. Order Number DE84009136.

From 23. Cracow school of theoretical physics; Zakopane, Poland (30 May 1983).

A number of novel features of QCD are reviewed, including the consequences of formation zone and color transparency phenomena in hadronic collisions, the use of automatic scale setting for perturbative predictions, null-zone phenomena as a fundamental test of gauge theory, and the relationship of intrinsic heavy colored particle Fock state components to new particle production. We conclude with a review of the applications of QCD to nuclear multiquark systems. 74 references.

29675 **Gravitational gauge fields and the cosmological constant.** Pagels, H.R. (Stanford Linear Accelerator Center, Stanford University, Stanford, California 94305 and The Rockefeller University, New York, New York 10021). *Physical Review [Section] D: Particles and Fields;* **29**: No. 8, 1690-1698(15 Apr 1984). Contract AC03-76SF00515;AC02-81ER40033.

We describe field theories for which the action is completely independent of the metric and connection of the space-time manifold. The metric in our approach is no more a fundamental field than a hadron field is a fundamental field in QCD. The fundamental fields in the action are O(5) gauge fields and combinations of these fields are interpreted as the metric and connection so that conventional general relativity is obtained. Remarkably, all renormalizable matter actions for scalar, spinor, and Yang-Mills gauge fields can be made metric independent. Significantly, we find a new elementary invariance of the action which implies the cosmological constant must vanish. Finally, we discuss the quantum theory resulting from these ideas.

29676 **Casimir energy of Higgs-field configurations in a Coleman-Weinberg-type theory.** Aoyama, H. (Stanford Linear Accelerator Center, Stanford University, Stanford, California 94305). *Physical Review [Section] D: Particles and Fields;* **29**: No. 8, 1763-1771(15 Apr 1984). Contract AC03-76SF00515.

The Casimir energy, the quantum correction part of the energy, of a class of space-dependent scalar field configurations is examined in a Coleman-Weinberg-type λphi⁴ theory in the d-dimensional regularization scheme. For the cases when the scalar field is dependent on only one space coordinate and partially excludes its fluctuations from a region of space, we develop formulas effective for evaluating the full one-loop Casimir energy. As an application, we evaluate a simple case and find that the Casimir energy yields the familiar quantum correction to the volume energy, an extra surface energy whose coefficient is finite for d< or =4, and a finite, exponentially small attractive term. It is shown that the divergences for d> or =5 are due to sharp boundaries of the conf'guration.

29677 **More uses for Wilson loops: Perturbation theory without Feynman diagrams.** Celmaster, W.; Kovacs, E. (Department of Physics, Northeastern University, Boston, Massachusetts 02115). *Physical Review [Section] D: Particles and Fields;* **29**: No. 8, 1772-1783(15 Apr 1984). Contract W-31-109-ENG-38.

For many arbitrary lattices with arbitrary SU(N) actions, it is easy to estimate the perturbative value of Λ/sub latt//Λ/sub MOM/ without calculating any Feynman diagrams. This observation, first made by Creutz, is based on the fact that perturbative expansions of Wilson loop ratios can be trivially extracted from Monte Carlo data at large β. Here, we extend Creutz's results to general loop ratios including those of polygons and parallelograms encountered on nonstandard lattices. In particular, we analytically compute the lowest-order quantum corrections to these loop ratios, discuss which ratios are free from divergences, and give specific Monte Carlo examples.

29678 **Strong magnetic field in spontaneously broken gauge theories.** Chakrabarti, J. (Institute of Theoretical Science, University of Oregon, Eugene, Oregon 97403). *Physical Review [Section] D: Particles and Fields;* **29**: No. 8, 1859-1860(15 Apr 1984). Contract AT06-76ER70004.

We make a few observations about the calculations of effective potentials of spontaneously broken gauge theories, in the pres-

ence of a strong magnetic field, by summation over vacuum energies.

29679 **Mass inequalities in quantum chromodynamics.** Nussinov, S. (Center for Theoretical Physics, Department of Physics and Astronomy, University of Maryland, College Park, Maryland 20742). *Physical Review Letters;* **52**: No. 12, 966-969(19 Mar 1984).

By use of variational arguments and flavor independence, p mass inequalities are derived between ground-state mesons, m/sub x/y-bar> or =(1/2)(m/sub xx/+m/sub yy/), and baryons, m/sub x/yy> or =(1/2)(m/sub xxy/+m/sub yyy/). .AE

29680 **Modification of predictions of grand unified theories in the presence of spontaneous compactification.** Shafi, Q.; Wetterich, C. (Bartol Research Foundation, University of Delaware, Newark, Delaware 19716). *Physical Review Letters;* **52**: No. 11, 875-878(12 Mar 1984). Contract AC02-78ER05007.

There are speculations that grand unified theories (GUT's) may arise from higher-dimensional models of gravity in which the extra dimensions are spontaneously compactified. The GUT predictions for proton decay and $\sin^2\theta$/sub w/ can be significantly modified when nonrenormalizable interactions, scaled by inverse powers of the compactification scale M/sub c/, are added to the standard GUT Lagrangian. For example, the decay rate for $p \to e^+\pi^0$ in minimal SU(5) can be lowered by one (two) orders of magnitude if M/sub c/ is on the order of 10^{17} GeV. However, $\sin^2\theta$/sub W/ then decreases by 0.005 (0.01). The SO(10) model is also discussed.

29681 **Chiral symmetry and the bag model: A new starting point for nuclear physics.** Thomas, A.W. (Division TH, CERN 1211 Geneva 23). *Advances in Nuclear Physics;* **13**: 1-137(1984). Contract AC02-76ER03074.

This chapter attempts to give the reader a fairly good working knowledge of the MIT bag model, as well as a degree of familiarity with chiral symmetry. Offers a detailed summary of the model, its underlying assumptions, its solutions, its predictions for the properties of single hadrons, and its unresolved problems. Explains the concept of chiral symmetry and why it must be broken in nature even though it is exact in pure QCD. Reviews the various attempts which have been made over the last 3 yrs. to make a bag model incorporating chiral symmetry. Discusses the basic bag model; the spectroscopy of low-lying states; attempts to derive a bag model; the relationship to nonrelativistic quark models; hadronic properties in the MIT bag model; charge radii; magnetic moments; the axial current; center of mass corrections; chiral symmetry; Lagrangian formulation of the MIT bag model; conserved currents in Lagrangian field theory; the axial current; the σ-model and spontaneous symmetry breaking; bag models with chiral symmetry; motivation; the work of Chodos and Thorn; the cloudy bag model; applications of the cloudy bag model; a Hamiltonian for low- and medium-energy physics; the nucleon; pion-nucleon scattering; magnetic moments of the nucleon octet; a new view of nuclear physics; the nucleon-nucleon force; symmetry breaking as a clue; and the nuclear many-body problem. Identifies the need to firmly establish a relationship between the MIT bag model, soliton bag models, and QCD.

29682 **Singularities in the perturbative QCD treatment of the photon structure functions.** Rossi, G. (Lawrence Berkely Lab., CA (USA); California Univ., Berkeley (USA). Dept. of Physics). *Physics Letters,* [*Section*] *B;* **130**: No. 1/2, 105-108(13 Oct 1983).

The perturbative QCD expansion for the calculable part of the Bjorken limit photon structure functions is shown to be affected by power singularities at $x = 0$ which spoil its convergence. Limitations on the calculability of the structure functions due to such singularities are discussed.

29683 **Supercomplimentarity in massless supersymmetric QCD.** Taylor, T.R. (Fermi National Accelerator Lab., Batavia, IL (USA)). *Physics Letters,* [*Section*] *B;* **128**: No. 6, 403-406(8 Sep 1983).

The presence of at least one supersymmetric phase is established for the strongly interacting SU(N) gauge theory with n flavors of massless matter in the N + anti N representation of the gauge group.

29684 **Numerical studies of gauge field theories.** Creutz, M.J. (Physics Dept., Brookhaven National Laboratory, Upton, NY 11973). pp 119-156 of The unity of the fundamental interactions. Zichichi, A. New York, NY; Plenum Publishing Corp. (1983). (CONF-810762—). Contract AC02-76CH00016.

From 19. international school of subnuclear physics; Erice, Italy (31 Jul 1981).

This chapter examines the application of Monte Carlo simulation of statistical systems by particle theorists to quantized gauge field theories. Finds strong numerical evidence that the standard SU(3) non-Abelian gauge theory of the strong interaction is capable of simultaneously confining quarks into the physical hadrons and exhibiting asymptotic freedom, the phenomenon of quark interactions being small at short distances. Describes experiments and implications of the results for strong interaction physics. Discusses the model; the string tension; the continuum limit and the renormalization group; phase transitions; and variants on the Wilson action. Attempts to show that lattice gauge theory is an exciting and a rapidly evolving technique for the particle physicist. Points out that the main obstacle at this stage is the inclusion of light quarks. Presents discussions featuring Morgan, Creutz, Karliner, Coleman, Teller and others.

29685 **Gauge theories of quark confinement in 2+1 dim: A comparative study of SU(2) Yang-Mills and Yang-Mills-Higgs systems.** Wadia, S.R. (The Enrico Fermi Inst. The University of Chicago, Chicago, IL 60637). pp 673-691 of Particles and fields. Capri, A.Z.; Kamal, A.N. New York, NY; Plenum Publishing Corp. (1983). (CONF-810882—). Contract AC02-80ER10558.

From 1981 Banff summer institute on particles and fields; Calgary, Alberta, Canada (16 Aug 1981).

This chapter summarizes some recent work on the confinement problem in 2+1 dim. Reviews the Debye-Hueckel screening mechanism of confinement in the Yang-Mills-Higgs system due to Polyakov. Uses the Polyakov model and D'Hoker's Monte-Carlo results as a guide to construct the vacuum of the pure SU(2) gauge theory in terms of adjoint monopoles. The mechanism of quark confinement in the pure gauge theory is the one proposed by Wilson, Kogut and Susskind. Finds that a vacuum of adjoint monopoles does lead to a correct screening theory in the sense that only SU(2) representations with non-trivial Z_2 charges are confirmed, unlike compact QED_3 where all representations are confined. Concludes that using the presented preliminary ideas, it may be possible to prove confinement in this model and apply the same sort of idea for 3+1 dimensions.

29686 **Hadronic wave functions and high momentum transfer interactions in quantum chromodynamics.** Brodsky, S.J.; Huang, T.; Lepage, G.P. (Stanford Linear Accelerator Center Stanford, CA 94305). pp 143-199 of Particles and fields. Capri, A.Z.; Kamal, A.N. New York, NY; Plenum Publishing Corp. (1983). (CONF-810882—). Contract AC03-76SF00515.

From 1981 Banff summer institute on particles and fields; Calgary, Alberta, Canada (16 Aug 1981).

This chapter emphasizes the utility of a Fock state representation of the meson and baryon wave functions as a means not only to parametrize the effects of bound state dynamics in QCD phenomena, but also to interrelate exclusive, inclusive, and higher twist processes. Discusses hadronic wave functions in QCD, measures of hadronic wave functions (form factors of composite systems, form factors of mesons, the meson distribution amplitude); large momentum transfer exclusive processes (two-photon processes); deep inelastic lepton scattering; and the phenomenology of hadronic wave functions (measures of hadron wave functions, constraints on the pion and proton valence wave function, quark jet diffraction excitation, the "unveiling" of the hadronic wave function and intrinsic charm). Finds that the testing ground of perturbative QCD where rigorous, definitive tests of the theory can be made can now be extended throughout a large domain of large momentum transfer exclusive and inclusive lepton, photon, and hadron reactions.

6455 Scattering Theory

29687 **(JINR-R—4-83-135) Calculation of two-center Coulomb scattering phases with the use of asymptotic expansions for irregular Coulomb spheroidal c-type functions.** Velikov, V.P.; Ivanov, K.I.; Marinov, A.T. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1983. 7p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE84701655.

A new method is proposed for calculating the Coulomb phases for scattering off two centers and of the normalization factors of the regular two-center Coulomb functions which satisfy a properly set condition at the origin. The numerical algorithm utilizes asymptotic expansions for the irregular c-type two-center Coulomb wave functions. This algorithm has been reatized in a FORTRAN program, which enabtes one to calculate phases and the normalization factors with the accuracy up to ten decimal places. Comparison of our method with others for calculating the Coulomb phases for scattering off two centers has shown that the same accuracy is reached by our method at a much faster rate and, likewise, for the same amount of computer time the accuracy is better in 4-5 places.

65 PHYSICS. II.

6510 Nuclear Physics

29688 **(INIS-SU—189) Nuclear constants.** (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow; Tsentral'nyj Nauchno-Issledovatel'skij Inst. Informatsii i Tekhniko-Ehkonomicheskikh Issledovanij po Atomnoj Nauke i Tekhnike, Moscow (USSR)). 1981. 56p. NTIS (US Sales Only), PC A04/MF A01. Order Number DE84780170.

Separate entries were made in the data base for the papers included. (WHK)

29689 (INIS-SU—198, pp 391) **Nuclear-physical aspects for thermonuclear investigations.** Kukulin, V.I.; Krasnopol'skij, V.M.; Voronchev, V.T. 1983. (In Russian). NTIS (US Sales Only), PC A99/MF A01. Order Number DE84780104. (CONF-8304144—Summs.). TI84780104

From 23. conference on nuclear spectroscopy and nuclear structure; Moscow, USSR (19 Apr 1983).

29690 **(LA-UR—84-1026) Preliminary proposals for extending the ENDF format to allow incident charged particles and energy-angle correlation for emitted particles.** MacFarlane, R.E.; Stewart, L.; Hale, G.M.; Dunford, C.L. (Los Alamos National Lab., NM (USA)). Apr 1984. Contract W-7405-ENG-36. 85p. (CONF-8404130—1). NTIS, PC A05; 3; GPO Dep. Order Number DE84009983.

From International Atomic Energy Consultants meeting on format for the exchange of evaluated neutron nuclear data; Vienna, Austria (1 Apr 1984).

Paper copy only, copy does not permit microfiche production.

This rewrite of Data Formats and Procedures for the Evaluated Nuclear Data File, ENDF pertains to the latest version, ENDF/B-VI. Earlier versions provided representations for neutron cross sections and distributions, photon production from neutron reactions, a limited amount of charged-particle production from neutron reactions, photo-atomic interaction data, thermal neutron scattering data, and radionuclide production and decay data (including fission products). This version allows higher incident energies, adds more complete descriptions of the distributions of emitted particles, and provides for incident charged particles and photo-nuclear data by partitioning the ENDF library into sublibraries. Decay data, fission product yield data, thermal scattering data, and photo-atomic data have also been formally placed in sublibraries. In addition, this rewrite represents an extensive update to the Version V manual.

29691 **(LBL—16281) Proceedings of the 6th high energy heavy ion study and 2nd workshop on anomalons.** (Lawrence Berkeley Lab., CA (USA)). Dec 1983. Contract AC03-76SF00098. 617p. (CONF-830675—). NTIS, PC A99/MF A01; GPO Dep. Order Number DE84005862.

From 6. high energy heavy ion study and 2. workshop on anomalons; Berkeley, CA, USA (28 Jun 1983).

Separate abstracts were prepared for 77 of the 84 papers presented. Seven of the papers were previously entered into the data base. (WHK)

6511 Experimental Techniques

REFER ALSO TO CITATION(S) 29133, 30089

29692 **(KFK—3553) Statistical inference of level densities from resolved resonance parameters.** Froehner, F.H. (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Inst. fuer Neutronenphysik und Reaktortechnik; Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Projekt Schneller Brueter). Aug 1983. 30p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE84751291.

Level densities are most directly obtained by counting the resonances observed in the resolved resonance range. Even in the measurements, however, weak levels are invariably missed so that one has to estimate their number and add it to the raw count. The main categories of missinglevel estimators are discussed in the present review, viz. (I) ladder methods including those based on the theory of Hamiltonian matrix ensembles (Dyson-Mehta statistics), (II) methods based on comparison with artificial cross section curves (Monte Carlo simulation, Garrison's autocorrelation method), (III) methods exploiting the observed neutron width distribution by means of Bayesian or more approximate procedures such as maximum-likelihood, least-squares or moment methods, with various recipes for the treatment of detection thresholds and resolution effects. The language of mathematical statistics is employed to clarify the basis of, and the relationship between, the various techniques. Recent progress in the treatment of resolution effects, detection thresholds and p-wave admixture is described.

29693 (LBL—16281, pp 81-82) **Detector for the measurement of projectile fragment interaction cross sections.** Dufour, J.P.; Girard, J.G.; Lindstrom, P.J.; Greiner, D.E.; Olson, D.L.; Symons, T.J.M.; Crawford, H.J. (Univ. of California, Berkeley). Dec 1983. NTIS, PC A99/MF A01. Order Number DE84005862. (CONF-830675—). TI84005862

From 6. high energy heavy ion study and 2. workshop on anomalons; Berkeley, CA, USA (28 Jun 1983).

A detector is being developed to measure the charge changing cross sections of secondary and tertiary projectile fragments produced in relativistic heavy ion collisions. This device is designed to provide a high statistics, electronic, analog to the measurements that have been made recently using plastic track detectors. If the detector is succesful and the anomalous component present in projectile fragmentation is observed, we intend to use the device in combination with the HISS spectrometer as a filter to study further the anomalous fragments.

29694 (LBL—16281, pp 83-85) **Development of a segmented Cerenkov detector for study of the "anomalon" phenomenon.** Stevenson, J.D.; Musser, J.A.; Barwick, S.W. (Univ. of California, Berkeley). Dec 1983. NTIS, PC A99/MF A01. Order Number DE84005862. (CONF-830675—). TI84005862

From 6. high energy heavy ion study and 2. workshop on anomalons; Berkeley, CA, USA (28 Jun 1983).

We plan to look for the anomalon effect using a stack of thin plastic Cerenkov paddles, each of which provides an independent measurement of the projectile fragment charge. Determination of the projectile fragment charge by measurement of the intensity of Cerenkov radiation is superior to ionization measurements because it is insensitive to fragments below the Cerenkov threshold of ~ 310 MeV/nucleon. Low-energy fragments represent a real danger in analysis of ionization-type experiments since fragments coming to

the end of range can mimic nuclear interactions. The chief disadvantage of the use of Cerenkov detectors is their feeble light output. The charge resolution of thin Cerenkov detectors is thus invariably limited by photon counting statistics and efficient light collection schemes are required to achieve satisfactory charge resolution.

29695 **(BONN-HE—83-13) ^{3}He electromagnetic form factors: A simple theoretical approach.** Bartnik, E.A.; Haberzettl, H.; Sandhas, W. (Bonn Univ. (Germany, F.R.). Physikalisches Inst.). Sep 1983. 10p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE84751293.

We derive an approximate formula for the charge form factor of ^{3}He, which is applicable for values of the squared momentum transfer larger than 6 fm^{-2}. Our result explicitly expresses the form factor in a very simple and direct way by the underlying two-body potentials.

29696 **(BONN-HE—83-14) Measurement of coherent pion-photoproduction on the ^{3}He/^{3}H isodublett.** Hartfiel, J.; Hilger, S.; Mutius, R.; Bellinghausen, B.; Gassen, H.J.; Noeldeke, G.; Reese, E.; Reichelt, T.; Stipp, P. (Bonn Univ. (Germany, F.R.). Physikalisches Inst.). Sep 1983. 10p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE84751292.

The authors describe the measurement of the differential cross sections for coherent photoproduction of π^0 on ^{3}He and ^{3}H and π^+ on ^{3}He in the Δ resonance region.

29697 **(CEA-CONF—6893) Exclusive electrodisintegration of ^{2}H far away off the quasielastic region.** Barreau, P.; Bernheim, M.; Bradu, P. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France)). Aug 1983. 2p. (CONF-830862—12-Summ.). NTIS (US Sales Only), PC A02/MF A01. Order Number DE84750618.

From 10. international conference on few-body problems in physics; Karlsruhe, F.R. Germany (21 Aug 1983).

Published in summary form only.

29698 **(CEA-CONF—6896) Differential cross section for elastic πip helium isotopes scattering.** Fournier, G.; Gerard, A.; Miller, J. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France)). Aug 1983. 2p. (CONF-830862—13-Summ.). NTIS (US Sales Only), PC A02/MF A01. Order Number DE84750619.

From 10. international conference on few-body problems in physics; Karlsruhe, F.R. Germany (21 Aug 1983).

Published in summary form only.

29699 **(CEA-CONF—6897) Electron scattering and few nucleon systems.** Frois, B. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France)). Aug 1983. 12p. (CONF-830862—14). NTIS (US Sales Only), PC A02/MF A01. Order Number DE84750624.

From 10. international conference on few-body problems in physics; Karlsruhe, F.R. Germany (21 Aug 1983).

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Recent result obtained by electron scattering in the few-nucleon systems (A <= 4) are presented. In particular, new experimental data have measured the tensor polarization, the magnetic form factor and the electrodisintegration of deuterium. A brief overview of the experimental situation is given together with a status of the theoretical interpretation. ^{3}He charge and magnetic form factors are discussed. New theoretical results indicate that three body forces improve considerably the saturation properties of ^{3}He, ^{4}He and nuclear matter, but are not able to reconcile experiment and theory for the charge form factors of ^{3}He and ^{4}He. Calculations of meson exchange effects with different theoretical approaches bring the theory into reasonable agreement with the experimental charge and magnetic form factor fo ^{3}He. Recent results of the measurements of the two and three body break-up of ^{3}He are discussed.

29700 (INIS-mf—8921, pp 26) **Recent experimental results on particle-hole structure of light nuclei.** Mordechai, S. (Ben-Gurion Univ. of the Negev, Beersheba (Israel). Dept. of Physics). 1983. NTIS (US Sales Only), PC A05/MF A01. Order Number DE84780235. (CONF-8303128—Summ.). TI84780235

From Israel Physical Society annual meeting; Ramat-Gan, Israel (24 Mar 1983).

29701 (INIS-SU—198, pp 159) **Radial oscillation excitation of ^{8}Be in α-α scattering.** Filippov, G.F.; Vasilevskij, V.S.; Nesterov, A.V. 1983. (In Russian). NTIS (US Sales Only), PC A99/MF A01. Order Number DE84780104. (CONF-8304144—Summs.). TI84780104

From 23. conference on nuclear spectroscopy and nuclear structure; Moscow, USSR (19 Apr 1983).

29702 (INIS-SU—198, pp 176) **Study on the nucleon-nucleon potential characteristics on the base of a d(e,esup(')pn reaction.** Popova, A.M.; Popov, Yu.V.; Shabalina, E.K. 1983. (In Russian). NTIS (US Sales Only), PC A99/MF A01. Order Number DE84780104. (CONF-8304144—Summs.). TI84780104

From 23. conference on nuclear spectroscopy and nuclear structure; Moscow, USSR (19 Apr 1983).

29703 (INIS-SU—198, pp 178) **Study on the role of two- and multi-particle interactions in low-nucleon systems.** Popova, A.M.; Shabalina, E.K.; Shablov, V.L. 1983. (In Russian). NTIS (US Sales Only), PC A99/MF A01. Order Number DE84780104. (CONF-8304144—Summs.). TI84780104

From 23. conference on nuclear spectroscopy and nuclear structure; Moscow, USSR (19 Apr 1983).

29704 (INIS-SU—198, pp 267) **Total cross section of neutrino (antineutrino) radiative scattering on deuteron with account for neutrino spectra.** Kerimov, B.K.; Ryzhikov, V.N.; Tsvetkoy, V.P. 1983. (In Russian). NTIS (US Sales Only), PC A99/MF A01. Order Number DE84780104. (CONF-8304144—Summs.). TI84780104

From 23. conference on nuclear spectroscopy and nuclear structure; Moscow, USSR (19 Apr 1983).

29705 (INIS-SU—198, pp 269) **Effect of second-class currents on angular distribution of beta decay products.** Kumar, J.; Samsonenko, N.V. 1983. (In Russian). NTIS (US Sales Only), PC A99/MF A01. Order Number DE84780104. (CONF-8304144—Summs.). TI84780104

From 23. conference on nuclear spectroscopy and nuclear structure; Moscow, USSR (19 Apr 1983).

29706 (INIS-SU—198, pp 409) **Study on the continuum spectrum states in the four-nucleon system.** Filippov, G.F.; Vasilevskij, V.S.; Kovalenko, T.P. 1983. (In Russian). NTIS (US Sales Only), PC A99/MF A01. Order Number DE84780104. (CONF-8304144—Summs.). TI84780104

From 23. conference on nuclear spectroscopy and nuclear structure; Moscow, USSR (19 Apr 1983).

29707 (INIS-SU—198, pp 412) **Coulomb interaction effect on the exchange amplitude singularities and the d $\rightarrow$ p + n nuclear vertex constant from the analysis of the p + d elastic backscattering.** Mukhamedzhanov, A.M.; Borbej, I.; Grubler, V.; Konig, V.; Shmelzbakh, P.A. 1983. (In Russian). NTIS (US Sales Only), PC A99/MF A01. Order Number DE84780104. (CONF-8304144—Summs.). TI84780104

From 23. conference on nuclear spectroscopy and nuclear structure; Moscow, USSR (19 Apr 1983).

29708 (INIS-SU—198, pp 451) **Method of accounting for Coulomb effects in N/D equations and its application to p-^{3}He and ^{3}He-^{4}Ho scattering.** Safronov, A.N. 1983. (In Russian). NTIS (US Sales Only), PC A99/MF A01. Order Number DE84780104. (CONF-8304144—Summs.). TI84780104

From 23. conference on nuclear spectroscopy and nuclear structure; Moscow, USSR (19 Apr 1983).

29709 (INIS-SU—198, pp 453) **Determination of P wave resonance parameters in pα scattering.** Safronov, A.N. 1983. (In Russian). NTIS (US Sales Only), PC A99/MF A01. Order Number DE84780104. (CONF-8304144—Summs.). TI84780104

From 23. conference on nuclear spectroscopy and nuclear structure; Moscow, USSR (19 Apr 1983).

29710 (LBL—16281, pp 181-184) **Limits on anomalon production in deuterium-deuterium collisions at 7.9 GeV/c.** Clarke, R.L.; Fernandes, D.N.; Hardy, J.E.; Hemingway, R.J.; Kessler, D.; Lefcoe, A.H.; Loken, C.; McPherson, A.C.; Pinfold, J.L.; Romo, W.J. (Carleton Univ., Ottawa, Canada; National Research Council, Ottawa, Canada). Dec 1983. NTIS, PC A99/MF A01. Order Number DE84005862. (CONF-830675—). TI84005862

From 6. high energy heavy ion study and 2. workshop on anomalons; Berkeley, CA, USA (28 Jun 1983).

A search for anomalous behaviour in the interactions of secondary particles produced in deuteron-deuteron collisions is described. This note reports our finding from a scan of bubble-chamber film taken at the Alternating Gradient Synchrotron at Brookhaven. The experiment (No. 341), a Princeton-Rutgers collaboration, exposed the BNL 80-in. deuterium bubble chamber to an almost pure (≧ 97%) beam of 7.9-GeV/c deuterons. Results are reported; the data do not support anomalon production. (WHK)

29711 **Isospin dependence of pion absorption on nucleon pairs at T/sub π/ = 65 MeV.** Moinester, M.A.; Gill, D.R.; Vincent, J.; Ashery, D.; Levenson, S.; Alster, J.; Altman, A.; Lichtenstadt, J.; Piasetzky, E.; Aniol, K.A. (TRIUMF, Vancouver, British Columbia, Canada V6T2A3). *Physical Review Letters;* **52**: No. 14, 1203-1206(2 Apr 1984).

Angular distributions of differential cross sections were measured for the first time for pion absorption on a T = 1, S = 0 nucleon pair and for absorption on a T = 0, S = 1 pair in the ^{3}He nucleus. A large isospin dependence is observed in the differential cross sections. The ratio of cross sections $\sigma(^3\mathrm{He}(\pi^+,2p))/\sigma(^3\mathrm{He}(\pi^-,pn))$ is 15.3 +- 1.2. The results show evidence of an isoscalar component of the final state in the reaction $^3\mathrm{He}(\pi^-,pn)n$, which cannot be mediated by Δ resonance formation.

29712 **Upper limit on the isovector parity-violating decay width of the 0^+ T = 1 state of ^{6}Li.** Robertson, R.G.H.; Dyer, P.; Melin, R.C.; Bowles, T.J.; McDonald, A.B.; Ball, G.C.; Davies, W.G.; Earle, E.D. (Cyclotron Laboratory and Physics Department, Michigan State University, East Lansing, Michigan 48824). *Physical Review* [*Section*] *C: Nuclear Physics;* **29**: No. 3, 755-763(Mar 1984).

A search has been made for a resonance in the $^2\mathrm{H}(\alpha,\gamma)$ ^{6}Li capture-reaction cross section at the energy corresponding to the 0^+, T = 1, 3.56-MeV state of ^{6}Li. None was found, and an upper limit of 6.5 x 10^{-7} eV was set on the parity-forbidden α width at the 90% confidence level. This limit is three orders of magnitude smaller than the best previous measurement.

29713 **Structure of the ^{3}H→n+d(d/sup /) vertexes.** Gibson, B.F.; Lehman, D.R. (Theoretical Division, Los Alamos National Laboratory, Los Alamos, New Mexico 87545). *Physical Review* [*Section*] *C: Nuclear Physics;* **29**: No. 3, 1017-1032(Mar 1984).

Models of ^{3}H are constructed from $^1S_0$ and $^3S_1$-$^3D_1$ separable interactions fitted to low-energy two-nucleon properties. In particular, a set of $^3S_1$-$^3D_1$ interactions is used that produces D-wave components in the deuteron with P/sub D/ = 0% to 10%. The ^{3}H binding energy (B_3), ^{3}H wave function component percentages, ^{3}H→n+d(d() asymptotic normalization constants, ^{3}H→n+d distorted wave parameters, percentage n-d component in the ^{3}H wave function, and ^{3}H→n+d momentum distribution are calculated for each case. From these results, numerous aspects of the ^{3}H→n+d(d() vertexes are examined. As examples: (1) dependence of the S- and D-wave ^{3}H→n+d asymptotic norms on P/sub D/ and B_3; (2) dependence of the ^{3}H→n+d(asymptotic norm on the scattering length and effective range of the $^1S_0$ interaction; (3) role of the D-wave component of the ^{3}H→n+d momentum distribution for n-d relative momentum between 0 and 2 fm^{-1}; and (4) validity of approximating the ^{3}H→n+d distorted-wave parameter, D_3, by the ratio of the D- to S-wave asymptotic normalization constants. Where possible, comparisons are made with local-potential calculations and experiment.

29714 **Isospin dependence of pion absorption on nucleon pairs.** Silbar, R.R.; Piasetzky, E. (Los Alamos National Laboratory, University of California, Los Alamos, New Mexico 87545). *Physical Review* [*Section*] *C: Nuclear Physics;* **29**: No. 3, 1116-1118(Mar 1984).

The suppressed ratio of (π^-, pn) to (π^+, pp) pion absorption cross sections on /sup 3,4/He has an important contribution from NN′ intermediate states, where N′ denotes a P_{11} πN interaction. The order-of-magnitude energy variation of this ratio, from stopped pions to pions above the (3,3) resonance, is reproduced in calculations using a unitary isobar model. We predict a strong asymmetry in the angular distribution of the ratio at higher pion energies.

29715 **(CONF-8403112—5) O^+ reversible O^- transitions in A=16.** Garvey, G.T. (Argonne National Lab., IL (USA)). 1984. Contract W-31-109-ENG-38. 24p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE84011709.

From International symposium on nuclear spectroscopy and nuclear interactions; Osaka, Japan (21 Mar 1984).

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Pseudoscalar matrix elements are of wide range interest to nuclear physicists at the present moment. The interest in these particular transitions is principally driven by the search for a predicted sizeable mesonic enhancement to the time-like part of the nucleonic axial current. This search has led to greatly improved experiments which have provided more precise determination of known O^+ to O^- transitions as well as measuring new ones. Also, there have been successful efforts to isolate the pseudoscalar part of J/sub i/ = J/sub f/, π/sub i/π/sub f/ = -1 transitions. Further, the theoretical analysis has become much more sophisticated with the inclusion of core polarization in both initial and final states. The bulk of this paper focuses on the O^+ to O^- transitions in A=16 as that is where our research has concentrated, but other cases are also cited. 33 references. (WHK)

29716 (INIS-mf—8921, pp 39) **4p and 6p-2h states in ^{20}O.** Mordechai, S. (Ben-Gurion Univ. of the Negev, Beersheba (Israel). Dept. of Physics); Lafrance, S.; Fortune, H.T.; Middleton, R. (Pennsylvania Univ., Philadelphia (USA). Dept. of Physics). 1983. NTIS (US Sales Only), PC A05/MF A01. Order Number DE84780235. (CONF-8303128—Summ.). TI84780235

From Israel Physical Society annual meeting; Ramat-Gan, Israel (24 Mar 1983).

29717 (INIS-mf—8921, pp 40) **Alpha transfer to ^{15}N and ^{16}O.** Mordechai, S. (Ben-Gurion Univ. of the Negev, Beersheba (Israel). Dept. of Physics); Fortune, H.T. (Pennsylvania Univ., Philadelphia (USA). Dept. of Physics). 1983. NTIS (US Sales Only), PC A05/MF A01. Order Number DE84780235. (CONF-8303128—Summ.). TI84780235

From Israel Physical Society annual meeting; Ramat-Gan, Israel (24 Mar 1983).

29718 (INIS-SU—198, pp 428) **Microscopic description of (p,n) reactions on 1p shell nuclei.** Gulyamov, M.G.; Kim, G.; Bekbaev, S.M.; Islomov, Z.R. 1983. (In Russian). NTIS (US Sales Only), PC A99/MF A01. Order Number DE84780104. (CONF-8304144—Summs.). TI84780104

From 23. conference on nuclear spectroscopy and nuclear structure; Moscow, USSR (19 Apr 1983).

29719 (INIS-SU—198, pp 443) **Phenomenological parametrization of a reduced width function in alpha-transfer reactions.** Gridnev, K.A.; Omer, Kh.M.; Semenov, V.M.; Subbotin, V.B. 1983. (In Russian). NTIS (US Sales Only), PC A99/MF A01. Order Number DE84780104. (CONF-8304144—Summs.). TI84780104

From 23. conference on nuclear spectroscopy and nuclear structure; Moscow, USSR (19 Apr 1983).

29720 (INIS-SU—198, pp 455) **Contribution of virtual excitations in diffraction scattering of protons and deuterons on ^{6}Li nucleus.** Goryachij, V.V.; Peresypkin, V.V. 1983. (In Russian). NTIS (US Sales Only), PC A99/MF A01. Order Number DE84780104. (CONF-8304144—Summs.). TI84780104

From 23. conference on nuclear spectroscopy and nuclear structure; Moscow, USSR (19 Apr 1983).

29721 (INIS-SU—198, pp 478) **Exchange processes in (α, d) and (α, t) reactions on boron isotopes.** Belyaeva, T.L.; Zelenskaya, N.S.; Teplov, I.B. 1983. (In Russian). NTIS (US Sales Only), PC A99/MF A01. Order Number DE84780104. (CONF-8304144—Summs.). TI84780104

From 23. conference on nuclear spectroscopy and nuclear structure; Moscow, USSR (19 Apr 1983).

29722 (LBL—16281, pp 3-17) **Mean free path of ^{40}Ar projectile fragments in CR39 track detectors.** Heinrich, W.; Drechsel, H.; Trakowski, W.; Beer, J.; Brechtmann, C.; Dreute, J.; Sonntag, S. (Univ. of Siegen, W. Germany). Dec 1983. NTIS, PC A99/MF A01. Order Number DE84005862. (CONF-830675—). TI84005862

From 6. high energy heavy ion study and 2. workshop on anomalons; Berkeley, CA, USA (28 Jun 1983).

This paper describes an experiment investigating the effect of anomalous short interaction mean free paths for fragments of relativistic heavy ions. We use a stack of CR39 plastic nuclear track detectors that was irradiated with 1.8 GeV/nucleon ^{40}Ar ions at the Berkeley Bevalac. About 1.5 . 10^{7} etch cones were measured in this experiment using an automatic measuring system. For 6444 nuclear collisions of fragments with charges 9-15 the interaction mean free path in the plastic was determined. This analysis cannot rule out the observations of enlarged cross sections for relativistic projectile fragments in the first centimeters after emission, but in contradiction to the experiments in nuclear emulsion the effect observed in our experiment is weaker and detectable only within the first centimeter. 10 references.

29723 (LBL—16281, pp 19-22) **Study of anomalous nuclear projectile fragments in reactions of 1.85A GeV ^{40}Ar in CR-39 etched track detector.** Tincknell, M.L.; Price, P.B. (Univ. of California, Berkeley). Dec 1983. NTIS, PC A99/MF A01. Order Number DE84005862. (CONF-830675—). TI84005862

From 6. high energy heavy ion study and 2. workshop on anomalons; Berkeley, CA, USA (28 Jun 1983).

Anomalous nuclear projectile fragments, or "anomalons," were first observed in cosmic rays by nuclear emulsion as a rapid series of nuclear interactions in a short distance. They were later seen as a statistical anomaly in secondary mean-free-paths (mfp's) in cosmic rays, and most recently and convincingly observed in high-statistics experiments using Bevalac beams which showed short mfp's for secondary fragments measured within the first few centimeters after the primary interactions. Because of the controversial and provocative nature of these reports, an alternative technique with different systematic errors and methodology is essential to confirm and illuminate the anomalon phenomenon. CR-39 etched track detector provides this alternative. It allows sampling of the electric charge with high resolution at approximately 600 μm intervals along a nuclear track, and thus successive nuclear charge-changing interactions in short distances can be observed. We report here the observation of depressed secondary mfp's in the first centimeter or so beyond the primary interactions in CR-39, in agreement with the previous emulsion work.

29724 (LBL—16281, pp 23-26) **First results from a repeat experiment on the mean free path of projectile fragments from 1.88 A GeV ^{56}Fe - emulsion interactions.** Karant, Y.J.; Heckman, H.H.; Friedlander, E.M. Dec 1983. NTIS, PC A99/MF A01. Order Number DE84005862. (CONF-830675—). TI84005862

From 6. high energy heavy ion study and 2. workshop on anomalons; Berkeley, CA, USA (28 Jun 1983).

In previous papers, we reported on results we had obtained on the mean free path (MFP) of secondary and later generation projectile fragments (PFs) from 1.88 A GeV ^{56}Fe primary nuclei incident on emulsion. We have repeated the experiment with careful systematic controls and report here our first results on the PF MFP.

29725 (LBL—16281, pp 27-42) **Mean free path of relativistic fragments from heavy ion reactions induced by 1.8A GeV ^{40}Ar in low sensitive nuclear emulsions.** Banaras; Chandigarh; Jaipur; Jammu; Lund. Dec 1983. NTIS, PC A99/MF A01. Order Number DE84005862. (CONF-830675—). TI84005862

From 6. high energy heavy ion study and 2. workshop on anomalons; Berkeley, CA, USA (28 Jun 1983).

Preliminary data is given for the mean free path of projectile-like fragments, $2 \leqq Z \leqq 18$, emitted in ^{40}Ar induced heavy ion reactions in nuclear emulsions at 1.8A GeV as well as in later generations of fragmentation chains. Only within a distance of one cm or less from the interaction point do we observe an enhanced collision frequency. If this observation is a signal of an anomalous fragmentation component this must have a very short mean free path or a lifetime less than 10^{-11} s. Some suggestions are given for systematic or statistical effects which could also possibly explain our results.

29726 (LBL—16281, pp 43-46) **Anomalous mean free path for Z=2 relativistic projectile fragments in emulsion.** El-Nadi, M.; Badawy, O.E.; El-Bakry, M.N.; Abdel-Salam, A.; El-Hamalawy, A.A.; Kaalil, E.I.; Mousa, A.M.; El-Nagdy, M. (Cairo Univ., Egypt). Dec 1983. NTIS, PC A99/MF A01. Order Number DE84005862. (CONF-830675—). TI84005862

From 6. high energy heavy ion study and 2. workshop on anomalons; Berkeley, CA, USA (28 Jun 1983).

The anomalous short mean free path (m.f.p.) of projectile fragments (p.f.) at small distances from emission vertex has been detected for fragments of $Z \geqq 3$ from different projectiles at energies up to $\simeq$ 2.0 A GeV. For $Z = 2$ fragments no clear cut conclusion is present. Here we report on some measurements of m.f.p. of $Z = 2$ ^{12}C p.f. at 4.5 GeV/C/N (the highest available momentum now). Two NIKFI-BR-2 nuclear emulsion stacks (10 cm x 20 cm x 600 μm pellicles dimensions), were tangentially irradiated with 4.5 GeV/C/N ^{12}C-ions and α-particles at the Synchrophasatron of the JINR, Dubna, USSR. 636, $Z = 2$ p.f.s. emitted in a 3^{0} cone were collected along the track scanning for the primary ^{12}C interactions. These p.f. were classified according to the number N/sub h/(N/sub h/ = number of heavily ionizing particles tracks) of the primary ^{12}C interaction events. Each p.f. was followed until it interacted or left the stack. The maximum path length detected for these p.f. amounts to $\simeq$ 150 mm. About 280 secondary interactions were collected.

29727 (LBL—16281, pp 47-50) **Are there anomalons at charge two: a comparison of helium induced primary and secondary interactions in nuclear research emulsion at about 2 GeV/nucleon.** Klein, N.; GanBauge, E.; Baagil, M.; Bieschke, U.; Killinger, F.; Kretschmer, R.; Laschek, A.; Weidner, W. (Philipps-Univ. Marburg, W. Germany). Dec 1983. NTIS, PC A99/MF A01. Order Number DE84005862. (CONF-830675—). TI84005862

From 6. high energy heavy ion study and 2. workshop on anomalons; Berkeley, CA, USA (28 Jun 1983).

A comparison of secondary α stars induced in emulsion by ^{56}Fe-primary beams at Bevalac energies of around 2 GeV/nucleon with primary stars of ^{3}He and ^{4}He of the same energy shows a clear difference in the asymmetry distribution of the target fragments as well as in the multiplicity distribution. Besides this a cut in

the data set of the secondaries at the distance D = 3 cm downstream from the emission point exhibits a special behaviour of the α-stars which are produced near to the primary star (D = 3 cm). A connection with the anomalon effect seems to be obvious.

29728 (LBL—16281, pp 51) **Behavior of secondary particles of charge two, three and four produced from relativistic heavy-ion collisions.** Jain, P.L.; Aggarwal, M.M.; El-Nagdy, M.S.; Ismail, A.Z.M.; Gomber, K.L. (State Univ. of New York, Buffalo). Dec 1983. NTIS, PC A99/MF A01. Order Number DE84005862. (CONF-830675—). TI84005862

From 6. high energy heavy ion study and 2. workshop on anomalons; Berkeley, CA, USA (28 Jun 1983).

We have used two small stacks of Ilford G-5 emulsion exposed to ^{56}Fe and ^{40}Ar beams at about 2 GeV parallel to the pellicles surfaces. Each pellicle was scanned by along-the-track method. We thus found about 6000 primary interactions from which about 6000 relativistic tracks of Z = 2 and about 800 tracks of Z = 3 and 4 emitted from the primary interactions within 0.2 rad forward cone were followed until they either interacted or left the stack. We observed about 850 secondary H/sub e/ interactions. The H/sub e/ fragments are easily identified by their distinct grain intensities (~ 4g min and for relativistic tracks it should not change within 2 cm of its path length followed from its production point) or by their δ-ray density measurements for Z = 2,3 and 4 fragments, the distance T available for its interaction in emulsion (the potential length) or if it interacted, the distance S to the interaction point was recorded. The mfp of interaction is given by λ = (Σ/sub i/d/sub i/)/N where Σ/sub i/d/sub i/ and N are the total path length of both interacting and noninteracting tracks and the number of interactions of the i particles within that path length interval, respectively. We shall discuss the mfp of H/sub e/ as a function of distances for different production angles and for Li and Be, we shall discuss mfp as a function of distance.

29729 (LBL—16281, pp 53-57) **Search for anomalons among singly charged relativistic particles from ^{16}O interactions at 2 GeV/nucleon.** Judek, B. (National Research Council of Canada, Ottawa, Ontario). Dec 1983. NTIS, PC A99/MF A01. Order Number DE84005862. (CONF-830675—). TI84005862

From 6. high energy heavy ion study and 2. workshop on anomalons; Berkeley, CA, USA (28 Jun 1983).

Mean free paths of singly charged relativistic secondary particles from ^{16}O interactions in emulsions have been measured. The results based on 1087 observed interactions indicate the presence of an anomalous component with a mean free path of about 5 cm, among the particles emitted in the angular interval corresponding to P tan θ between 200 and 400 MeV/c. 8 references.

29730 (LBL—16281, pp 65-68) **About a possible energy dependence of the anomalon effect at charge two.** Killinger, F.; GanBauge, E.; Bieschke, U.; Klein, N.; Kretschmer, R.; Laschek, A.; Weidner, W. (Philipps Univ., Marburg, W. Germany). Dec 1983. NTIS, PC A99/MF A01. Order Number DE84005862. (CONF-830675—). TI84005862

From 6. high energy heavy ion study and 2. workshop on anomalons; Berkeley, CA, USA (28 Jun 1983).

The reaction mean-free paths of projectile fragments of charge two seem to be shorter for a few centimeters after their emission than at larger distances from the primary star. This effect is enhanced with decreasing energy of the primary beam. If this can be shown to be true it possibly would explain why the anomalon effect which was established at charges Z ≧ 3 has not been found at Z = 2 in earlier work. Our target was an emulsion stack exposed to a ^{56}Fe beam of around 1.88 A GeV at the Berkeley Bevalac. 8 references.

29731 (LBL—16281, pp 69-72) **Search for topological correlations in the interactions of relativistic projectile fragments from relativistic heavy ion collisions.** Friedlander, E.M.; Heckman, H.H.; Karant, Y.J. Dec 1983. NTIS, PC A99/MF A01. Order Number DE84005862. (CONF-830675—). TI84005862

From 6. high energy heavy ion study and 2. workshop on anomalons; Berkeley, CA, USA (28 Jun 1983).

Following the observation of anomalously short mean free paths among projectile fragments from relativistic heavy ion collisions it was a natural next step to investigate what correlations, if any, exist between the characteristics of the events in which "anomalons" are produced, of those which they induce, as well as with their interaction mean free path. We report here the preliminary results of a search from correlations between the properties of production and interaction stars of He-secondaries from the extra-nuclear cascade induced by a beam of 1.88 A GeV Fe. The aim of this investigation, performed to date on a limited subsample of events from stack ^{3}Fe, was to identify parameters most sensitive to correlation studies, to be pursued with larger statistics on the whole available material.

29732 (LBL—16281, pp 73-76) **Particle-gamma coincidence measurements in ^{12}C + ^{12}C and ^{12}C + Pb collisions at 2.1 GeV/A incident energy, first results - γ-ray spectrum.** Roche, G.; Carroll, J.; Chang, C.C.; Hallman, T.; Kirk, P.N.; Koontz, R.; Krebs, G.; Madansky, L.; Mulera, T.; Pugh, H. (Universite de Clermont-Ferrand, France; Univ. of California, Los Angeles; Univ. of Maryland, College Park; Johns Hopkins Univ., Baltimore, MD; Louisiana State Univ., Baton Rouge). Dec 1983. NTIS, PC A99/MF A01. Order Number DE84005862. (CONF-830675—). TI84005862

From 6. high energy heavy ion study and 2. workshop on anomalons; Berkeley, CA, USA (28 Jun 1983).

High-energy γ-rays are mainly produced through π^0 decay in relativistic heavy ion collisions at incident energies in the range 1-2 GeV/A. Other possible weak contributions are: nucleus-nucleus bremsstrahlung, eta-meson production, and Δ(1232) decay. Up to now, only a few experimental studies have been done on this subject. More recently, γ-ray measurements have been performed to study projectile fragments having an anomalously short interaction length, i.e., the so-called anomalons. Liss, et al. have searched for single delayed gammas as an eventual decay process. Their negative result does not completely rule out a possible electromagnetic decay of an anomalous state, because their measurement was done at 940 MeV/A, an energy at which it has been suggested that the effect could have disappeared. We have undertaken a different approach to the study of anomalous fragments. First, the study is done in the target fragmentation region. Second, we look for singly charged anomalous fragments through particle-gamma coincidence measurements. Our experimental method consists in looking for any sharp line or bump in γ-ray spectra in coincidence with particles and, ultimately, looking for any signal in the particle-gamma invariant mass distribution. We present here the experimental setup and preliminary results on the measured gamma-ray spectrum.

29733 (LBL—16281, pp 77-80) **Studies of anomalous projectile fragments with lead-glass, plastic track detectors, and Cerenkov detectors.** Price, P.B. (Univ. of California, Berkeley). Dec 1983. NTIS, PC A99/MF A01. Order Number DE84005862. (CONF-830675—). TI84005862

From 6. high energy heavy ion study and 2. workshop on anomalons; Berkeley, CA, USA (28 Jun 1983).

Status of the following studies is briefly described: search for delayed gamma decays of anomalous nuclear states, search for non-integrally charged projectile fragments in relativistic nucleus-nucleus collisions, study of anomalous fragments of 1.85A GeV ^{40}Ar reactions in CR-39 detectors, measurements of charge-changing interaction mean free paths of stable nuclei with plastic track detectors, comparison of anomalous mean free paths in compacted and dilute CR-39 stacks, and development of a segmented Cherenkov detector for study of the anomalon phenomenon. (WHK)

29734 (LBL—16281, pp 237-239) **Coincidence experiments between pions (π/sup +-/) and forward charged particles from intermediate energy heavy ion collisions.** Julien, J.; Bolore, M.; Charlot, X.; Hisleur, J-M.; Legrain, R.; Pappalardo, G.S.; Poitou, J.; Johansson, T.; Guet, C.; Maurel, M. . (Centre d'Etudes Nucleaires Saclay, France; The Gustaf. Werner Inst., Uppsala, Sweden; Centre d'Etudes Nucleaires, Grenoble, France; INFN and Univ. Catania, Italy). Dec 1983. NTIS, PC A99/MF A01. Order Number DE84005862. (CONF-830675—). TI84005862

From 6. high energy heavy ion study and 2. workshop on anomalons; Berkeley, CA, USA (28 Jun 1983).

Pions being one of the most commonly produced particles in heavy ion collisons, one ought to have a very clear understanding of the associated pion production mechanism. Data obtained from subthreshold pion production inclusive measurements can be compared with the predictions of some of the conventional models. Nevertheless they are not sufficient to discriminate among these different models. For that, a necessary step is the realization of exclusive measurements. This paper describes an attempt of coincidence experiment between charged pions and forward emitted charged particles. A few results from a preliminary analysis of the data are presented. The experiment was carried out with the ^{12}C beam (85 MeV/A) of the CERN Synchrocyclotron using a ^{12}C target.

29735 (LBL—16281, pp 259-262) **Production of light fragments with high P/sub T/ at cm 90 degrees in 800 MeV/nucleon ^{12}C + ^{12}C collisions.** Bai, X.; Hamagaki, H.; Hashimoto, O.; Kadota, S.; Kimura, K.; Miake, Y.; Nagamiya, S.; Omata, K.; Shida, Y.; Tanihata, I. (Inst. of Atomic Energy, Beijing, China; Kyushu Univ., Fukuoka, Japan; Univ. of Tokyo, Hongo, Japan). Dec 1983. NTIS, PC A99/MF A01. Order Number DE84005862. (CONF-830675—). TI84005862

From 6. high energy heavy ion study and 2. workshop on anomalons; Berkeley, CA, USA (28 Jun 1983).

The experiment was designed to measure inclusive spectra of protons and light fragments emitted to CM 90 degrees with extreme high energy (E/sub K//sup CM/ > 700 MeV or P/sub Lab/ = 2 ~ 3 GeV/c) as well as correlations between particles emitted +- 90 degrees in the CM frame. We studied the 800 MeV/nucleon ^{12}C + ^{12}C reaction using a newly completed HISS (Heavy Ion Spectrometer System) facility at the BEVALAC. Preliminary data are presented. (WHK)

29736 (LBL—16281, pp 357-360) **Complex WKB solutions for ^{12}C+^{12}C scattering.** Townsend, L.W.; Bidasaria, H.B.; Wilson, J.W. (NASA Langley Research Center, Hampton, VA; Old Dominion Univ., Norfolk, VA). Dec 1983. NTIS, PC A99/MF A01. Order Number DE84005862. (CONF-830675—). TI84005862

From 6. high energy heavy ion study and 2. workshop on anomalons; Berkeley, CA, USA (28 Jun 1983).

WKB solutions for carbon-carbon scattering from 200 to 360 MeV are obtained using a double-folding optical potential with no arbitrarily adjustable parameters. Significant improvements over previous results are obtained when values for the energy-dependent nucleon-nucleon scattering slope parameter are limited to those appropriate to diffractive scattering. 12 references.

29737 **Angular distribution for $^{15}N(\pi^+,\pi^0)^{15}O$(g.s.) at T/sub π/ = 48 MeV p.** Cooper, M.D.; Baer, H.W.; Bolton, R.; Bowman, J.D.; Cverna, F.; King, N.S.P.; Leitch, M.; Alster, J.; Doron, A.; Erell, A. (Los Alamos National Laboratory, Los Alamos, New Mexico 87545). *Physical Review Letters;* **52**: No. 13, 1100-1103(26 Mar 1984).

Pion single charge exchange to the isobaric analog state of ^{15}N was measured at T/sub π/ = 48 MeV over the angular range 0—150°. The angle-integrated cross section at 48 MeV is 0.43 +- 0.07 mb. The most prominent feature in the measured angular distribution is a deep minimum near 0°. The data are compared with optical-model calculations and the effects of various second-order terms in the potential are investigated.

29738 **Charge-changing reactions of secondary fragments produced in high-energy heavy-ion collisions.** Symons, T.J.M.; Baumgartner, M.; Dufour, J.P.; Girard, J.; Greiner, D.E.; Lindstrom, P.J.; Olson, D.L.; Crawford, H.J. (Nuclear Science Division, Lawrence Berkeley Laboratory, Berkeley, California 94720). *Physical Review Letters;* **52**: No. 12, 982-985(19 Mar 1984). Contract AC03-76SF00098.

Charge-changing cross sections have been measured for secondary fragments produced by the interactions of 1.88A-GeV ^{56}Fe and 1.82A-GeV ^{40}Ar nuclei in Lucite. The cross sections are found to vary by less than 1.5% between 6 and 120 mm from the primary interaction point and are consistent with values expected from the normal reaction cross sections of primary beams. No correlation between secondary and tertiary path lengths has been observed. The present results do not provide supporting evidence for the existence of anomalons.

6514 Nuclear Properties And Reactions, A=20-38, Theoretical

29739 **(INIS-mf—8372) Study of the (p,α)-reaction on sd-shell nuclei and their microscopic analysis.** Hoyler, F. (Tuebingen Univ. (Germany, F.R.). Fakultaet fuer Physik). 14 Jul 1982. 158p. (In German). NTIS (US Sales Only), PC A08/MF A01. Order Number DE84780175.

In the present thesis the (p,α) reaction on the 2s-1d-shell nuclei ^{23}Na, ^{24}Mg, ^{26}Mg, ^{27}Al, ^{35}Cl, ^{37}Cl, and ^{39}K was measured. The experiments were performed at the isochronous cyclotron JULIC of the Institute for Nuclear Physics of the Nuclear Research Facility Juelich and at the Emperor Van-de-Graaff accelerator of the Max Planck Institute for Nuclear Physics Heidelberg. Angular distributions for transitions to several residual nucleus states were evaluated in the energy range between 18 and 45 MeV incident proton energy. By the application of magnetic spectrometers as detection device an energy resolution between 25 and 45 keV could be reached.

29740 **(INIS-mf—8375) Precision measurement of the asymmetry coefficient in the β-γ-angular correlation in ^{24}Na.** Steuer, D. (Erlangen-Nuernberg Univ., Erlangen (Germany, F.R.). Naturwissenschaftliche Fakultaet 1 - Mathematik und Physik). 20 Jul 1982. 70p. (In German). NTIS (US Sales Only), PC A04/MF A01. Order Number DE84780177.

In the present thesis the asymmetry coefficient of the β-γ angular correlation function in the β^- decay of ^{24}Na to the second excited state of ^{24}Mg was measured in dependence of the energy of the detected electrons. The nucleus ^{24}Na was produced via the reaction ^{23}Na (d,p) ^{24}Na at the Erlangen tandem accelerator. Because of the half-life of the sample of 15.02 hours it was possible to perform the measurements thereafter in the laboratory. For the detection of the β-γ coincidence events a symmetric arrangement of two surface barrier detectors for the electron detection and two NaI detectors for the detection of the γ quanta was applied. With this arrangement it was possible to take up simultaneously two coincident counting rates for the angles theta = 90° and theta = 180° between electron and γ quant. The data acquisition was performed three-dimensionally. In the data evaluation especially the correction of the results to randomly coincidents events as well as really coincident events from the cascade $4^+ \to 2^+ \to 0^+$ in ^{24}Mg was regarded. The electron spectrum was devided into three energy ranges, and for each of these ranges the asymmetry coefficient of the angular correlation was determined separately. A comparison of these experimentally determined values with theoretical predictions shows that the experiment cannot by described by the hitherto present shell model calculations.

29741 (LBL—16281, pp 321-324) **Two-pion correlations for 1.2 GeV/nucleon Ar on KCl.** Beavis, D.; Chu, S.Y.; Fung, S.Y.; Gorn, W.; Huie, A.; Keane, D.; Lu, J.J.; Poe, R.T.; VanDalen, G.; Vient, M. (Univ. of California, Riverside). Dec 1983. NTIS, PC A99/MF A01. Order Number DE84005862. (CONF-830675—). TI84005862

From 6. high energy heavy ion study and 2. workshop on anomalons; Berkeley, CA, USA (28 Jun 1983).

The technique of pion interferometry is used to study the pion source for central collisions of 1.2 GeV/nucleon Ar on KCl. The data are described by a Gaussian source of radius 3.8 +- .5 fm, a lifetime of (18 +- 6) x 10^{-24} sec and a degree of coherence of .74 +- .17. 7 references.

29742 (LBL—16281, pp 333-336) **Pion spectra in the reaction Ar + KCl at 1.8 GeV/nucleon.** Brockmann, R.; Harris, J.W.; Maier, M.; Sandoval, A.; Stock, R; Stroebele, H.; Wolf, K.L.; Pugh, H.G.; Schroeder, L.S.; Renfordt, R.E. (Gesellschaft fuer Schwerionenforschung, Darmstadt, W. Germany; Lawrence Berkeley Lab., CA; Univ. Heidelberg, W. Germany). Dec 1983. NTIS, PC A99/MF A01. Order Number DE84005862. (CONF-830675—). TI84005862

From 6. high energy heavy ion study and 2. workshop on anomalons; Berkeley, CA, USA (28 Jun 1983).

Pion production in the symmetric system Ar + KCl was studied in the energy range 0.4-1.8 GeV/nucleon using the Streamer Chamber Facility at the Bevelac. The main purpose of this experiment was to measure a complete set of pion spectra, in order to test existing and future theoretical models describing the pion production and absorption in nucleus-nucleus collisions at higher nuclear densities. Up to now there exists no theoretical or phenomenological approach that reproduces all the features of the pion production mechanism, though specific aspects are well reproduced by several models. We report some observations that were made in central collisions at an incoming energy of 1.8 GeV/nucleon, which to our knowledge are not predicted by any of the existing theoretical or phenomenological approaches.

29743 (LBL—16281, pp 345-348) **Inclusive K^+-production in the model of transport theory for high-energy nucleus-nucleus collisions.** Zwermann, W.; Schuermann, B.; Dietrich, K.; Martschew, E. (Technischen Univ. Munchen, Garching, W. Germany). Dec 1983. NTIS, PC A99/MF A01. Order Number DE84005862. (CONF-830675—). TI84005862

From 6. high energy heavy ion study and 2. workshop on anomalons; Berkeley, CA, USA (28 Jun 1983).

The inclusive differential cross section for K^+-meson production in the reaction Ne + NaF at 2.1 GeV/N is calculated within an independent multiple collision approach, neglecting the possible influence of the rescattering of the produced kaons by surroundinng particles. We use the near-analytical, parameter-free model of transport theory with slight modifications, to determine the momentum distributions of the colliding particles after each number of collisions, taking account of pion production via the delta resonance.

29744 **Low multipolarity magnetic transitions in ^{32}S excited by electron scattering.** Burt, P.E.; Fagg, L.W.; Crannell, H.; Sober, D.I.; Stapor, W.; O'Brien, J.T.; Lightbody, J.W.; Maruyama, X.K.; Lindgren, R.A.; Sargent, C.P. (Catholic University of America, Washington, DC 20064). *Physical Review [Section] C: Nuclear Physics;* **29**: No. 3, 713-721(Mar 1984).

Electron scattering cross section measurements on ^{32}S have been made at incident electron energies between 34 and 74 MeV and at scattering angles of 162.4° and 180°. Form factors were deduced for transitions to states at 8.11, 9.68, 10.05, 10.78, 11.12, and 11.63 MeV. Additional peaks at 7.12, 12.02, and 13.36 MeV were observed in some spectra. Comparisons of cross sections at different angles show that the above six transitions are transverse. Comparison of the experimental form factors with those calculated using an oscillator shell model indicate that the 8.11, 9.68, 11.12, and 11.63 MeV transitions are M1. Transition probabilities B(M1)up-arrow = 1.14 +- 0.18, 0.69 +- 0.20, 2.40 +- 0.22, and 1.26 +- 0.20 μ_0^2, respectively, were determined for these four transitions. The M1 form factors and transition probabilities are also compared with other theoretical shell model calculations. The transition at 10.78 MeV is probably M2, or a mixture of M2 and transverse E2 transitions to unresolved states at about that energy.

29745 **Pion-induced monopole transitions.** Sparrow, D.A.; Gerace, W.J. (Department of Physics, University of Pennsylvania, Philadelphia, Pennsylvania 19104). *Physical Review [Section] C: Nuclear Physics;* **29**: No. 3, 949-955(Mar 1984).

The importance of imposing the orthogonality condition between the initial and final state wave functions for a correct description of the direct contribution to the monopole cross section is demonstrated in the context of a study of $^{28}Si(\pi,\pi')$. Two step effects, previously found important for the ^{12}C monopole excitation, are less important in this reaction. Very general estimates of two-step contributions are derived. These indicate that multistep effects will be small in medium energy monopole excitations away from forward angles.

29746 (CONF-8403101—7) **Projectile fission in ^{58}Ni-induced reactions at 15.3 MeV/u.** Awes, T.C.; Ferguson, R.L.; Novotny, R.; Obenshain, F.E.; Plasil, F.; Rauch, V.; Sann, H.; Young, G.R. (Oak Ridge National Lab., TN (USA)). 9 Mar 1984. Contract AC05-84OR21400. 5p. NTIS, PC A02/MF A01; GPO Dep. Order Number DE84011651.

From 3. winter workshop on nuclear dynamics; Copper Mountain, CO, USA (5 Mar 1984).

The present study was intended as a search for sequential fission of projectilelike fragments for reactions induced by intermediate-mass heavy ions. The objective was to determine the fission probability as a function of excitation energy or energy loss in the first step of the reaction. The inclusive charge distributions measured with the large-area ionization chamber for reactions of ^{58}Ni + ^{58}Ni at 15.3 MeV/u were found to be dominated by products with $Z < 28$. Very little yield was observed for nuclei with charges greater than that of the projectile. It has been shown that most of the shift toward lighter products is consistent with the effects of equilibrium evaporation. At the largest calculated energy losses, the inclusive charge distributions were found to be slightly asymmetric due to an increasing component of fragments with half or less of the projectile charge. These light fragments were observed to have much broader angular distributions than the corresponding heavier fragments of the same energy loss. These observations from the inclusive measurements already suggest the occurrence of sequential fission of the projectilelike fragment. More conclusive evidence is obtained from coincidence measurements. Results are presented. (WHK)

29747 (INIS-mf—8365, pp 165) **Description of heavy-ion scattering by direct multistep reaction in the region between quasielastic and deep-inelastic reactions.** Lenske, H.; Landowne, S.; Wolter, H.H.; Tamura, T. (Muenchen Univ. (Germany, F.R.). Sektion Physik); Udagawa, T. (Texas Univ., Austin (USA)). 1984. (In German). NTIS (US Sales Only), PC A09/MF A01. Order Number DE84780230. TI84780230

In Annual report 1982 of the Beschleunigerlaboratorium of Univ. and Technische Univ. Muenchen.

29748 (INIS-mf—8921, pp 38) **^{43}K from the $^{41}K(t,p)$ reaction.** Mordechai, S. (Ben-Gurion Univ. of the Negev, Beersheba (Israel). Dept. of Physics); Fortune, H.T. (Pennsylvania Univ., Philadelphia (USA). Dept. of Physics). 1983. NTIS (US Sales Only), PC A05/MF A01. Order Number DE84780235. (CONF-8303128—Summ.). TI84780235

From Israel Physical Society annual meeting; Ramat-Gan, Israel (24 Mar 1983).

29749 (INIS-SU—198, pp 277) **Effect of nuclear structure on bremsstrahlung spectra of multiply charged particles.** Amus'ya, M.Ya.; Potapova, T.M.; Gul'karov, I.S. 1983. (In Russian). NTIS (US Sales Only), PC A99/MF A01. Order Number DE84780104. (CONF-8304144—Summs.). TI84780104

From 23. conference on nuclear spectroscopy and nuclear structure; Moscow, USSR (19 Apr 1983).

29750 (INIS-SU—198, pp 423) **To the problem of determination of an integral cross section of γ quantum yield at nucleus de-excitation.** Bazavov, D.A.; Kashuba, I.E. 1983. (In Russian). NTIS (US Sales Only), PC A99/MF A01. Order Number DE84780104. (CONF-8304144—Summs.). TI84780104

From 23. conference on nuclear spectroscopy and nuclear structure; Moscow, USSR (19 Apr 1983).

29751 (INIS-SU—198, pp 435) **Proton elastic scattering on complex nuclei.** Dzhavadov, A.V.; Mirabutalybov, M.M.; Tveretskij, A.P. 1983. (In Russian). NTIS (US Sales Only), PC A99/MF A01. Order Number DE84780104. (CONF-8304144—Summs.). TI84780104

From 23. conference on nuclear spectroscopy and nuclear structure; Moscow, USSR (19 Apr 1983).

29752 (INIS-SU—198, pp 472) **Modification of boundary conditions in an optical scattering model.** Poznyakov, Yu.A.; Terenetskij, K.O. 1983. (In Russian). NTIS (US Sales Only), PC A99/MF A01. Order Number DE84780104. (CONF-8304144—Summs.). TI84780104

From 23. conference on nuclear spectroscopy and nuclear structure; Moscow, USSR (19 Apr 1983).

29753 **(KFK—3555) Local density approximation in effective density-dependent αN-interactions.** Gils, H.J. (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Inst. fuer Kernphysik). Nov 1983. 33p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE84751305.

Different forms of a local density approximation (LDA) in effective density-dependent αN-interactions are compared in single-folding optical model analyses of elastic α particle scattering by sup(40,42,44,48)Ca at Esub(α)=104 MeV and by ^{40}Ca at Esub(α) = 140 MeV. It is shown that the form of the LDA considerably influences the results on folded optical potentials. A variable form of the LDA is suggested and discussed which includes previous forms as limiting cases. The new form leads to better fits to the data and to full consistency with the best available "model-independent" optical potentials.

29754 (LBL—16281, pp 309-311) **Azimuthal angular correlations between heavy projectile fragments and light particles in the reaction ^{18}O + Ni at 84 MeV/u.** Mueller, W.F.J.; Gobbi, A.; Hildenbrand, K.D.; Olmi, A.; Sann, H.; Stelzer, H.; Bock, I.; Lynen, U.; Pelte, D.; Winkler, U. (GSI, Darmstadt, W. Germany; MPI Heidelberg, W. Germany; Universitaet Heidelberg, W. Germany; Universitaet Muenster, W. Germany). Dec 1983. NTIS, PC A99/MF A01. Order Number DE84005862. (CONF-830675—). TI84005862

From 6. high energy heavy ion study and 2. workshop on anomalons; Berkeley, CA, USA (28 Jun 1983).

An intermediate energies between 30-100 MeV/u the formation of a hot spot has been predicted, a reaction mechanism halfway between deep-inelastic scattering and participant-spectator behavior. As a localized excitation the hot spot may decay by particle evaporation as well as by heat conduction to the interior of the nuclear residues. In inclusive measurements in addition to evaporation from target and projectile a source at mid-rapidity has been observed which may result either from hot spot evaporation or from quasi-free nucleon-nucleon scattering. To investigate whether the mid-rapidity source in peripheral reactions is localized at the nuclear surface a coincidence experiment has been done at the 84 MeV/u ^{18}O beam of the CERN-SC. The set-up was used to study the correlation between projectile fragments and light charged particles. Results are reported.

29755 (LBL—16281, pp 325-328) **Two particle correlations observed with the plastic ball detector.** Wieman, H.; Gutbrod, H.H.; Gustafsson, H.A.; Kolb, B.; Loehner, H.; Ludewigt, B.; Poskanzer, A.M.; Renner, T.; Riedesel, H.; Ritter, H.G. (Gesellschaft fuer Schwerionenforschung, Darmstadt, W. Germany; Lawrence Berkeley Lab., CA). Dec 1983. NTIS, PC A99/MF A01. Order Number DE84005862. (CONF-830675—). TI84005862

From 6. high energy heavy ion study and 2. workshop on anomalons; Berkeley, CA, USA (28 Jun 1983).

Three different categories of two-particle correlations are being investigated in the analysis of the Plastic Ball data. The first category is source size determination using Hanbury-Brown, Twiss type interferometry. Two-pion correlations have been measured for this purpose with a streamer chamber and with a magnetic spectrometer. Source size measurements have also been made with proton-proton correlations following the calculations of Koonin, which include Coulomb and nuclear forces in addition to strictly interference effects. In this category of two-particle correlations the relative velocities are quite low. For protons the kinetic energy in the center of mass of the pair is on the order of 0.5 MeV. The second category of two-particle correlations deals with low-energy nuclear cluster formation, the kinetic energy in the pair center of mass being in the region 1 MeV to 10 MeV. Here one observes nuclear composites - the formation and decay of particle unstable isotopes and levels such as ^{5}Li. The third category addresses higher energies, 100 MeV or more in the center of mass of the pair. In this energy region the possibility exists for seeing baryon resonances. For example, delta decay might be observed via π^+-p correlations or dibaryon resonanced by π^+-d correlations. Preliminary results obtained in the first two categories are reported.

29756 **Core-excitation effects in pion double charge exchange.** Seth, K.K.; Kaletka, M.; Iversen, S.; Saha, A.; Barlow, D.; Smith, D.; Liu, L.C. (Northwestern University, Evanston, Illinois 60201). *Physical Review Letters;* **52**: No. 11, 894-897(12 Mar 1984).

Differential cross sections for the pion double-charge-exchange reaction ^{42}Ca(π^+, π^-)^{42}Ti(g.s.) have been mesured at θ/sub lab/ = 5° at several energies. For T(π^+)<200 MeV, σ(5°) are found to be more than an order of magnitude larger than those predicted by conventional double-charge-exchange calculations. It is shown that the observed enhancements can be explained in terms of coherent contributions due to terms proportional to rho^2(r) in the pion-nucleus potential whose importance is dramatically enhanced in presence of large core-excitation components in ^{42}Ca(g.s.).

29757 **(INIS-mf—8373) Particle multiplets and collective excitations in the odd-odd nucleus ^{74}Br.** Neumann, W. (Koeln Univ. (Germany, F.R.). Mathematisch-Naturwissenschaftliche Fakultaet). 12 Feb 1983. 103p. (In German). NTIS (US Sales Only), PC A06/MF A01. Order Number DE84780178.

The odd-odd nucleus ^{74}Br was gamma-spectroscopically studied via the reaction ^{58}Ni(^{19}F,2pnγ)^{74}Br. Single γ-spectra, γ-excitation functions, γ-γ coincidences, γ-angular distributions, and mean life-times were measured by the recoil-distance method in coincidence with the neutron evaporated from the compound nucleus. The term scheme was extended by 14 new levels and 7 life-time assignments. For the measurement of parity changes a magnetic spectrometer of the 'Mini-Orange' type was constructed which works equally in coincidence with neutrons. By it in ^{74}Br 8 conversion coefficients were measured. Calculations in a rotor-plus-2-quasiparticle model and calculations of the multiplet splitting of one-particle states of f, p, and g shells of this mass region permit a compared to the transition probabilities, sufficient interpretation of the most states ^{74}Br in that way, that these different structures could be identified just as mixtures of collective and one-particle excitations.

29758 (INIS-SU—198, pp 215) **Fragmentation of two-particle states of spherical nuclei.** Voronov, V.V. 1983. (In Russian). NTIS (US Sales Only), PC A99/MF A01. Order Number DE84780104. (CONF-8304144—Summs.). TI84780104

From 23. conference on nuclear spectroscopy and nuclear structure; Moscow, USSR (19 Apr 1983).

29759 (INIS-SU—198, pp 404) **Total radiative widths of neutron resonances and photon dipole strength function of compound-compound gamma transitions.** Kadmenskij, S.G.; Lomachenkov, I.A.; Popov, A.B.; Furman, V.I. 1983. (In Russian). NTIS (US Sales Only), PC A99/MF A01. Order Number DE84780104. (CONF-8304144—Summs.). TI84780104

From 23. conference on nuclear spectroscopy and nuclear structure; Moscow, USSR (19 Apr 1983).

29760 (INIS-SU—198, pp 448) **Fluctuation of neutron widths and selection of optical nuclear potential parameters.** Kashuba, I.E.; Bazavov, D.A.; Golubova, A.A.; Prikhod'ko, V.P. 1983. (In Russian). NTIS (US Sales Only), PC A99/MF A01. Order Number DE84780104. (CONF-8304144—Summs.). TI84780104

From 23. conference on nuclear spectroscopy and nuclear structure; Moscow, USSR (19 Apr 1983).

29761 (LBL—16281, pp 59-62) **Search for short-lived anomalons in projectile fragmentation.** Gustafsson, H.A.; Gutbrod, H.H.; Kolb, B.; Ludewigt, B.; Poskanzer, A.M.; Renner, T.; Riedesel, H.; Ritter, H.G.; Warwick, A.I.; Wieman, H.H. (Gesellschaft fuer Schwerionenforschung, Darmstadt, West Germany; Lawrence Berkeley Lab., CA). Dec 1983. NTIS, PC A99/MF A01. Order Number DE84005862. (CONF-830675—). TI84005862

From 6. high energy heavy ion study and 2. workshop on anomalons; Berkeley, CA, USA (28 Jun 1983).

Nuclear emulsion studies suggest that fragmentation products from relativistic heavy ion collisions have anomalously large reaction cross sections and that these anomalons disappear over the first few centimeters of their track in emulsions. If these "anomalons" exist, their disappearance could be due to either depletion by a very large reaction cross section, or decay with a mean lifetime of about 10^{-11} seconds and with only somewhat enhanced cross section. The counter experiment described here was designed to test the decay model proposed by Barber et al. that explains the emulsion data by assuming that all produced fragments are anomalons with 1.6 times the cross section of normal fragments and that the anomalons have a mean lifetime (tau) of about 10^{-11} s corresponding to a mean decay length ($c\beta\gamma$tau) of 9 mm. If the disappearance in emulsions is due to decay, one should observe a decreased number of secondary interactions in a low-density target, compared to the number observed in a solid target. We have conducted an experiment based on this density effect. The experiment was performed by bombarding alternatively a solid (20 mm thick) and a dilute (ten 2-mm slabs each separated by 20 mm) Cu target with a beam of 1.7 GeV/u ^{56}Fe ions at the Berkeley Bevalac. The produced projectile fragments were detected, within a cone of +- 1° opening angle 5.5 m downstream, in ΔE plastic scintillators having successive thicknesses of 1, 6, and 38 mm.

29762 (LBL—16281, pp 63-64) **Search for anomalon decay by radiochemical methods.** Dersch, G.; Aleklett, K.; Beckmann, R.; Brandt, R.; Friedlander, E.M.; Loveland, W.; Lund, T.; McGaughey, P.; Porile, N.; Seaborg, G.T. (Philipps Univ., Marburg, W. Germany; Studsvik Science Research Lab., Nykoeping, Sweden; Lawrence Berkeley Lab., CA; Oregon State Univ., Corvallis; Purdue Univ., W. Lafayette, IN). Dec 1983. NTIS, PC A99/MF A01. Order Number DE84005862. (CONF-830675—). TI84005862

From 6. high energy heavy ion study and 2. workshop on anomalons; Berkeley, CA, USA (28 Jun 1983).

We present preliminary data on the tests of a radiochemical approach to the investigation of the stability of projectile fragments from relativistic heavy ion collisions. The recent emulsion evidence for anomalously short mean free paths of a least part of such projectile fragments ("anomalons") can be interpreted (most simplistically) by two extreme hypotheses, viz: (a) Anomalons are essentially stable over the distances accessible to the emulsion experiments (~ 10 cm) and, (b) Most anomalons return to the nuclear ground state ("normal" cross-section) with a mean life-time comparable to the time necessary for traversal of such distances. Although the experiment described is sensitive, in principle, to the presence of stable anomalons, too, its main aim is to test hypothesis (b), above.

29763 (CONF-8403117—1) **Model for fission-product calculations.** Smith, A.B. (Argonne National Lab., IL (USA)). 1984. Contract W-31-109-ENG-38. 14p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE84010525.

From Meeting of the Nuclear Energy Agency Nuclear Data Commission; Jaeri, Japan (12 Mar 1984).

Portions are illegible in microfiche products.

Many fission-product cross sections remain unmeasurable thus considerable reliance must be placed upon calculational interpolation and extrapolation from the few available measured cross sections. The vehicle, particularly for the lighter fission products, is the conventional optical-statistical model. The applied goals generally are: capture cross sections to 7 to 10% accuracies and inelastic-scattering cross sections to 25 to 50%. Comparisons of recent evaluations and experimental results indicate that these goals too often are far from being met, particularly in the area of inelastic scattering, and some of the evaluated fission-product cross sections are simply physically unreasonable. It is difficult to avoid the conclusion that the models employed in many of the evaluations are inappropriate and/or inappropriately used. In order to alleviate the above unfortunate situations, a regional optical-statistical (OM) model was sought with the goal of quantitative prediction of the cross sections of the lighter-mass (Z = 30-51) fission products. The first step toward that goal was the establishment of a reliable experimental data base consisting of energy-averaged neutron total and differential-scattering cross sections. The second step was the deduction of a regional model from the experimental data. It was assumed that a spherical OM is appropriate: a reasonable and practical assumption. The resulting OM then was verified against the measured data base. Finally, the physical character of the regional model is examined.

29764 (INIS-mf—8369) **Studies on the electron capture decay of ^{146}Gd, ^{147}Gd, ^{147}Eu and ^{150}Dy, as well as precision measurements of Qsub(EC) energies.** Kantus, R. (Goettingen Univ. (Germany, F.R.). Mathematisch-Naturwissenschaftliche Fakultaet). 6 Nov 1981. 55p. (In German). NTIS (US Sales Only), PC A04/MF A01. Order Number DE84780180.

For the study of the EC decay energies of isotopes near Z=64 a CAMAC measuring system was established, and programs for the acquisition of coincidence and single data as well for the analysis of the obtained data were developed. By the method of the measuring of relative capture probabilities a lower limit for the decay energy of ^{146}Gd of Qsub(EC)(^{146}Gd)>950 keV was determined. By determination of the β^+/EC branching ratio in the decay of ^{150}Dy for the decay energy a lower limit of 1826 keV was found by which for the decay energy of ^{146}Gd regarding the α decay energy of ^{150}Dy a value of 950 keV < Qsub(EC)(^{146}Gd) < 1064 keV results. Furthermore the level scheme of the ^{146}Gd decay was studied, and 4 new levels at 114, 421, 498, and 690 keV were determined whereby the hitherto assumed levels at 115, 742, and 806 keV could be excluded. The EC decay energy of ^{147}Gd and ^{147}Eu was also determined by the method of the β^+/EC determination and the values Qsub(EC)(^{147}Gd)=2088+-45 keV and Qsub(EC)(^{147}Eu)=1669+- 30 keV. The level scheme of the ^{147}Eu decay was reexamined. The levels at 121, 197, 798, 1064, 1063, 1077, 1318, 1454, 1471, and 1549 keV could be confirmed whereas the level at 1646 keV could be excluded. Transitions from further levels indicated in literature couldn't be observed in the present measurement, but cannot be excluded within the error limits.

29765 (INIS-SU—189, pp 43-50) **Radioactive nuclide yields for thick target at 22 MeV protons.** Dmitriev, P.P.; Molin, G.A. 1981. (In Russian). NTIS (US Sales Only), PC A04/MF A01. Order Number DE84780170. TI84780170

In Nuclear constants.

Experimental results on the radioactive nuclide yields at irradiating thick targets with 22 MeV protons have been presented. The 188 yield values have been measured for the 140 radionuclides ranging from ^{11}C to ^{207}Bi. The radionuclide production reaction radioactive nuclide characteristics used in activity measurements (half life, energy and γ-ray quantum yield) have been given.

29766 (INIS-SU—198, pp 189) **Structure of low-lying excited states of antimony isotopes with A 113-121.** Kovrigin, O.D.; Mitroshin, V.E. 1983. (In Russian). NTIS (US Sales Only), PC A99/MF A01. Order Number DE84780104. (CONF-8304144—Summs.). TI84780104

From 23. conference on nuclear spectroscopy and nuclear structure; Moscow, USSR (19 Apr 1983).

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29767 (INIS-SU—198, pp 205) **Calculation of nucleus properties in a new magic region near Z = 64.** Artamonov, S.A.; Isakov, V.I.; Ogloblin, S.G.; Sliv, L.A.; Shaginyan, V.P. 1983. (In Russian). NTIS (US Sales Only), PC A99/MF A01. Order Number DE84780104. (CONF-8304144—Summs.). TI84780104

From 23. conference on nuclear spectroscopy and nuclear structure; Moscow, USSR (19 Apr 1983).

29768 (INIS-SU—198, pp 219) **Version of effective nuclear interaction.** Artamonov, S.A.; Isakov, V.I.; Ogloblin, S.G. 1983. (In Russian). NTIS (US Sales Only), PC A99/MF A01. Order Number DE84780104. (CONF-8304144—Summs.). TI84780104

From 23. conference on nuclear spectroscopy and nuclear structure; Moscow, USSR (19 Apr 1983).

29769 (INIS-SU—198, pp 231) **Calculation of moment of inertia of rare earth nuclei in semiphenomenological model with the Skyrme forces.** Tarasov, V.N; Gonchar, V.Yu. 1983. (In Russian). NTIS (US Sales Only), PC A99/MF A01. Order Number DE84780104. (CONF-8304144—Summs.). TI84780104

From 23. conference on nuclear spectroscopy and nuclear structure; Moscow, USSR (19 Apr 1983).

29770 (INIS-SU—198, pp 462) **One-center Coulomb adiabatic basis for the coupled channel method.** Il'in, A.P. 1983. (In Russian). NTIS (US Sales Only), PC A99/MF A01. Order Number DE84780104. (CONF-8304144—Summs.). TI84780104

From 23. conference on nuclear spectroscopy and nuclear structure; Moscow, USSR (19 Apr 1983).

29771 (LBL—16281, pp 225-235) **Collective effects in subthreshold pion production.** Grosse, E. (GSI Darmstadt, W. Germany). Dec 1983. NTIS, PC A99/MF A01. Order Number DE84005862. (CONF-830675—). TI84005862

From 6. high energy heavy ion study and 2. workshop on anomalons; Berkeley, CA, USA (28 Jun 1983).

Collective effects in the pion production from collisions of 60-84 MeV/u ^{12}C and ^{18}O projectiles as well as ^{40}Ar ions of 44 MeV/u with targets from A = 12 to A = 232 seem to be established. The picture of a coherent bremsstrahlung like pion emission caused by a collective deceleration of the projectile (resp. an acceleration of the target) describes the data reasonably well. It is tested by also observing electromagnetic bremsstrahlung, i.e. high energy gamma rays. Using the slowing down parameters from the analysis of the π^0 spectra one calculates electromagnetic bremsstrahlung with an intensity of about the same order of magnitude as that part of the observed gamma spectra which is not originating from π^0 decay. This consistency indicates the possibility to perform a detailed study of the internuclear collision dynamics and especially the slowing down process by observing bremsstrahlung of the strong and electromagnetic interactions simultaneously. From the analysis of the pion production data available so far it appears that at energies around 60 MeV/u violent nucleus nucleus collisions are occurring in which a big portion of the kinetic energy is taken out of the relative motion through a fast slowing down process taking place within about 1 fm. 15 references.

29772 (LBL—16281, pp 255-258) **Inclusive measurements of pions and light fragments in 800 MeV/nucleon ^{139}/sub 57/La + ^{139}/sub 57/La collisions.** Bai, X.; Hamagaki, H.; Hashimoto, O.; Kimura, K.; Kobayashi, T.; Miake, Y.; Nagamiya, S.; Shapiro, G.; Shida, Y.; Tanihata, I. (Univ. of Tokyo, Japan; Univ. of Calif., Berkeley; Inst. of Atomic Energy, Beijing, China; Kyushu Univ., Fukuoka, Japan). Dec 1983. NTIS, PC A99/MF A01. Order Number DE84005862. (CONF-830675—). TI84005862

From 6. high energy heavy ion study and 2. workshop on anomalons; Berkeley, CA, USA (28 Jun 1983).

The 800 Mev/nucleon La beam was accelerated at the upgraded BEVALAC. The beam intensity on the target was as high as 10^6 particles/spill. The magnetic spectrometer was used to measure negative pions in the momentum range above 150 MeV/c and light fragments between 400 MeV/c and 2000 MeV/c at laboratory angles of 15, 20, 40, 60, 80, and 90 degrees. Preliminary data for momentum distributions of protons and pions at various laboratory angles are shown. Proton and pion energy distributions at CM 90 degrees for the La + La reaction are plotted together with the C + C, Ne + NaF and Ar + KCl reactions. (WHK)

29773 (LBL—16281, pp 305-308) **Angular correlations between target and projectile fragments emitted from ^{238}U + Ag(Br) collisions at 0.85 A GeV.** Heckman, H.H.; Friedlander, E.M.; Karant, Y.J. Dec 1983. NTIS, PC A99/MF A01. Order Number DE84005862. (CONF-830675—). TI84005862

From 6. high energy heavy ion study and 2. workshop on anomalons; Berkeley, CA, USA (28 Jun 1983).

Our examination of inelastic nuclear interactions of ~ 1A GeV ^{238}U in research emulsions revealed a large range of target/projectile multiplicities, from simple binary fission to complete disintegration of both the uranium projectile and target nucleus into nucleons and light nuclear fragments. A particular class of U-reactions that we have begun to study are those that exhibit the classical target/projectile fragment topologies, selected by the criteria that at least 10 target- and 10 projectile-related fragments are produced in the reaction. Such reactions, when observed in emulsion, are identified with collisions of the incident uranium ions with the heavy component, Ag(Br), of the emulsion. Because of the high multiplicities of both target and projectile fragments, statistically meaningful measurements on the angular correlations between the target and projectile fragments becomes possible on an event-by-event basis. The status of the measurements is described.

29774 (LBL—16281, pp 329-331) **Composite particle production measured with the plastic ball.** Renner, T.R.; Gustafsson, H.A.; Gutbrod, H.H.; Kolb, B.; Loehner, H.; Ludewigt, B.; Poskanzer, A.M.; Riedesel, H.; Ritter, H.G.; Warwick, A. (Gesellschaft fuer Schwerionenforschung, Darmstadt, W. Germany; Lawrence Berkeley Lab., CA). Dec 1983. NTIS, PC A99/MF A01. Order Number DE84005862. (CONF-830675—). TI84005862

From 6. high energy heavy ion study and 2. workshop on anomalons; Berkeley, CA, USA (28 Jun 1983).

One of the questions to be answered by studying collisions of nuclei at relativistic energies is whether phase transitions can occur in nuclear matter. Several models have suggested changes in entropy as a signature of such a phase transition. More recently a suggestion has been made that one measure of entropy might be the comparison of the deuteron yield to the proton yield. A further refinement has been made that proposes measuring the number of real and virtual deuterons to determine entropy. The measurements of these quantities up until this time has been done with single particle inclusive measurements. As has been shown recently with results from the Plastic Ball such measurements average over impact parameters. Consequently, information about quantities that have a charge particle multiplicity or impact parameter dependence is lost. The results to be reported on in this work indicate just such a dependence of d-like/p-like on charge particle multiplicity.

29775 (LBL—16281, pp 363-372) **Search for a possible deconfinement phase transition in nuclear matter by proton and anti-proton interactions with nuclei at 200 GeV.** Derado, I. (Max-Planck-Institut fuer Physik und Astrophysik, Muenchen, Germany). Dec 1983. NTIS, PC A99/MF A01. Order Number DE84005862. (CONF-830675—). TI84005862

From 6. high energy heavy ion study and 2. workshop on anomalons; Berkeley, CA, USA (28 Jun 1983).

Results for correlation between [p/sub perpendicular/] and multiplicity in the central rapidity region are presented. No correlation is observed. In the central collisions, i.e., by higher multiplicity, one could expect higher energy density and/or temperature resulting in an increase of [p/sub perpendicular/]. Such an increase has been observed in the anti pp collider experiment. However, our energy is much lower than that of a collider. We have obtained values for the size and lifetime of the pion producing region for both hydrogen and xenon targets. For both targets the values are similar, with radius about 1.5 fermis. This result is consistent with our previous observation that the proton interacts inside the nucleus in the manner, predicted by the additive quark model. This analysis shows no indication of a deconfinement phase transition in nuclear matter.

29776 (LBL—16281, pp 385-388) **Particle densities in ultrarelativistic heavy ion reactions extrapolated from proton-nucleus collisions.** Otterlund, I.; Garpman, S.; Lund, I. (Univ. of Lund, Sweden). Dec 1983. NTIS, PC A99/MF A01. Order Number DE84005862. (CONF-830675—). TI84005862

From 6. high energy heavy ion study and 2. workshop on anomalons; Berkeley, CA, USA (28 Jun 1983).

Rapidity density distributions in central ultrarelativistic heavy ion reactions are estimated from high energy proton-nucleus collisions and compared with some cosmic ray events. Deviations from a simple scaling of pA reactions are observed. 8 references.

29777 (LBL—16281, pp 389-392) **Analysis of the high multiplicity events in ultra-relativistic heavy ion collisions.** Sumiyoshi, H. (Univ. of Tokyo, Japan). Dec 1983. NTIS, PC A99/MF A01. Order Number DE84005862. (CONF-830675—). TI84005862

From 6. high energy heavy ion study and 2. workshop on anomalons; Berkeley, CA, USA (28 Jun 1983).

From the view point that a high energy nucleus-nucleus interaction is composed of the multiple nucleon-nucleon collisions, we analyze the multiplicities of the ultra-relativistic heavy ion collisions. Most of the experimental data are well settled within our framework. It is concluded that the multiplicity is insensitive to the quark-gluon plasma (QGP) formation or QGP has not yet been created within the observed events. 17 references.

29778 (LBL—16281, pp 393-403) **Lepton scattering from nuclear targets.** Bodek, A. (Univ. of Rochester, NY). Dec 1983. NTIS, PC A99/MF A01. Order Number DE84005862. (CONF-830675—). TI84005862

From 6. high energy heavy ion study and 2. workshop on anomalons; Berkeley, CA, USA (28 Jun 1983).

Experimental results on deep inelastic lepton scattering from nuclear targets are discussed with emphasis on electron scattering experiments. Also discussed are experiments that have recently been completed and experiments that are about to begin data taking in the near future. A short summary of current theoretical ideas on quark distributions in nuclei is also presented. An analysis of electron scattering and neutrino scattering data from hydrogen and deuterium indicates that nuclear effects in the deuteron are small. 39 references.

29779 (LBL—16281, pp 563-566) **Possible candidates for quark-gluon plasma in the JACEE emulsion chamber.** Burnett, T.H.; Dake, S.; Fuki, M.; Gregory, J.C.; Hayashi, T.; Holynski, R.; Iwai, J.; Jones, W.V.; Jurak, A.; Lord, J.J. (Univ. of Tokyo, Japan; Kobe Univ., Japan; Osaka Univ. Japan; Waseda Univ., Tokyo, Japan; Louisiana State Univ., Baton Rouge). Dec 1983. NTIS, PC A99/MF A01. Order Number DE84005862. (CONF-830675—). TI84005862

From 6. high energy heavy ion study and 2. workshop on anomalons; Berkeley, CA, USA (28 Jun 1983).

Cosmic ray nucleus-nucleus interactions have been analyzed at energies exceeding 1 TeV/nucleon. A high P/sub T/ tail ([P/sub T/] $\geq$ 1 - 1.2 GeV/c) has been observed in C + C interactions, and three anomalous central collision events (Ar + Pb, Ca + C, and Si + AgBr) each imply energy densities $\geq$4.0 - 4.6 GeV/fm^3, for an expansion time of 1 fm/c, which exceed the predicted critical value for quark-gluon deconfinement. The average P/sub T/ for these anomalous events is significantly above normal (400 MeV/c).

29780 (LBL—16281, pp 579-582) **Evidence for the non-existence of anomalous projectile fragments with Z* = 1.33, 1.67, 2.33 and 2.67.** Bloomer, M.A.; Friedlander, E.M.; Heckman, H.H.; Karant, Y.J. Dec 1983. NTIS, PC A99/MF A01. Order Number DE84005862. (CONF-830675—). TI84005862

From 6. high energy heavy ion study and 2. workshop on anomalons; Berkeley, CA, USA (28 Jun 1983).

Recent speculation on the cause of the anomalously short reaction mean free paths of projectile fragmentation products (PF's) produced from relativistic heavy-ion (RHI) collisions with emulsion nuclei has led to the suggestion that "anomalons" (i.e., the fraction of PF's exhibiting this anomaly) are nuclei with bound third-integral charges. In an earlier paper we described in detail how to measure the nuclear charge of $1 \leq Z \leq 3$ PF's of RHI collisions in nuclear emulsion: specifically, measurements based on the lacunarity, i.e., fractional transparency, of the linear track structure of such ionization tracks will easily yield a precision of $\sigma = 0.05$ charge units for $Z = 1$ and $Z = 2$, and about $\sigma = 0.07$ charge units for $Z = 3$. We now present the results of 1179 measurements carried out by 3 observers on $1 \leq Z \leq 3$ PF's produced by the extra-nuclear cascade of interactions initiated by a 1.88 A GeV ^{56}Fe beam incident upon a stack of Ilford G-5 emulsion pellicles.

29781 (LBL—16281, pp 607-626) **Are anomalons still provocative: a summary of the present experimental situation.** Otterlund, I. (Univ. of Lund, Sweden). Dec 1983. NTIS, PC A99/MF A01. Order Number DE84005862. (CONF-830675—). TI84005862

From 6. high energy heavy ion study and 2. workshop on anomalons; Berkeley, CA, USA (28 Jun 1983).

A number of experiments have shown that enlarged cross sections exist for projectile fragments which are emitted in relativistic heavy ion collisions. The present status of these investigations is reviewed and new detector techniques for anomalon search are discussed. Most experiments are compatible with an assumption that the anomalon effect is smaller than 3% and appears within distances shorter than about 2 cm from the parent reaction. 39 references.

29782 **Gamma-ray cascade population of the (19/2)$^-$ isomer in the decay of ^{133}Te/sup m/ to levels of ^{133}I.** Walters, W.B.; Henry, E.A.; Meyer, R.A. (Department of Chemistry, University of Maryland, College Park, Maryland 20742). *Physical Review [Section] C: Nuclear Physics;* **29**: No. 3, 991-1004(Mar 1984). Contract W-7405-ENG-48.

We have studied the decay of 55.4-min ^{133}Te/sup m/ to the levels of ^{133}I. The population of 47 excited states in ^{133}I following the decay of ^{133}Te/sup m/ is proposed and evidence for ten additional states is discussed. The observed decay patterns are found to be strongly influenced by the levels populated in the β decay of the (11/2)$^-$ parent cascade through an intermediate energy three-particle (19/2)$^-$ isomer rather than simply decaying by E1 γ rays to the lower-lying positive parity levels. We discuss the role of these structurally controlled γ ray cascades on processes occurring in nuclides near closed shells.

29783 **(EFI—552(39)-82) Description of correlations between the multiplicities of πp mesons and nonrelativistic protons in nucleus-nucleus interactions at 4,2 GeV/c momentum per nucleon.** Gulkanyan, G.R.; Korchagin, S.A.; Rabinovich, I.M. (Erevanskij Fizicheskij Inst. (USSR)). 1982. 13p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE84701681.

The correlations between the multiplicities of π^--mesons and nonrelativistic protons in collisions of light nuclei with a heavy target-nucleus are calculated in the model of independently interacting nucleons. The calculations results are compared with experimental data on the interactions of (p, d, He, C) with a tantalum (Ta) nucleus at 4.2 GeV/c momentum per nucleon, obtained at a 2m propane bubble chamber of JINR with an internal tantalum.

29784 (INIS-mf—8703, pp 171) **Gamma-ray linear polarization measurement on the "SPIN" facility.** Ferencei, J.; Benda, V.; Finger, M.; Petrik, M.; Jankech, A. (Joint Inst. for Nuclear Research, Dubna (USSR)); Rikovska, J.; Novakova, D. (Ceske Vysoke Uceni Technicke, Prague (Czechoslovakia)). 1981. (In Czech). NTIS (US Sales Only), PC A08/MF A01. Order Number DE84780103. (CONF-8108164—Pt.1-Vol.1). TI84780103

From 7. conference of Czechoslovak physicists; Prague, Czechoslovakia (24 Aug 1981).

29785 (INIS-mf—8921, pp 37) **Evidence for E1-E2 interference in the ^{159}Tb(γ,n) reaction.** Birenbaum, Y.; Berant, Z.; Kahane, S.; Moreh, R.; Wolf, A. (Israel Atomic Energy Commission, Beersheba. Nuclear Research Center-Negev). 1983. NTIS (US Sales Only), PC A05/MF A01. Order Number DE84780235. (CONF-8303128—Summ.). TI84780235

From Israel Physical Society annual meeting; Ramat-Gan, Israel (24 Mar 1983).

29786 **γ-γ energy correlations and the moments of inertia in ^{176}W.** Lee, I.Y.; Baktash, C.; Saladin, J.X. (Oak Ridge National Laboratory, Oak Ridge, Tennessee 37830). *Physical Review [Section] C: Nuclear Physics;* **29**: No. 3, 837-842(Mar 1984).

The behavior of ^{176}W at high angular momentum was investigated through both spectroscopy of the discrete and correlation measurements of the continuum γ rays. The γ-γ coincidence data were taken with a detection system consisting of two Compton-suppressed Ge(Li) counters. First and second moments of inertia were derived from the data.

29787 **Angular-momentum-dependent fission barriers in the rare-earth region.** Plasil, F.; Awes, T.C.; Cheynis, B.; Drain, D.; Ferguson, R.L.; Obenshain, F.E.; Sierk, A.J.; Steadman, S.G.; Young, G.R. (Oak Ridge National Laboratory, Oak Ridge, Tennessee 37831). *Physical Review [Section] C: Nuclear Physics;* **29**: No. 3, 1145-1148(Mar 1984).

Fission and evaporation residue excitation functions of ^{153}Tb and ^{181}Re compound systems are investigated in the context of angular-momentum-dependent fission barrier calculations in which effects of the finite range of the nuclear force and of the diffuseness of the nuclear surface are included. Carbon- and neon-induced reactions are studied in both the ^{153}Tb and ^{181}Re cases. Reasonable agreement is found between experimental and calculated excitation functions without adjustments of the theoretical fission barriers.

6519 Nuclear Properties And Reactions, A=190-219, Theoretical

29788 (CEA-CONF—6911) **Determination of the total photonuclear absorption cross section for Pb in the Δ-resonance region.** Carlos, P.; Arends, J.; Beil, H. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France)). Sep 1983. 1p. (CONF-830833—19-Summ.). NTIS (US Sales Only), PC A02/MF A01. Order Number DE84750620.

From International conference on nuclear physics; Florence, Italy (29 Aug 1983).

Published in summary form only.

29789 (INIS-mf—8374) **Studies on the alpha decay of polonium.** Steinmayer, T.W.R. (Tuebingen Univ. (Germany, F.R.). Fakultaet fuer Physik). 22 Dec 1982. 74p. (In German). NTIS (US Sales Only), PC A04/MF A01. Order Number DE84780174.

The theory on the alpha decay originating from Wildermuth is presented with some specifications justified by the following. For the description of the inert Pb core oscillator functions are applied which permit together with the Gauss functions serving as continuous base for the alpha particles an explicit antisymmetrization and analytic integration of all occurring matrix elements. This point of view led to the choice of the two-body forces with Gaussian-like radial dependence presented by Volkov; the Coulomb potential was microscopically correctly regarded. The analytical integrability of all matrix elements was required by inclusion of one-body excitations up to ca. 30 quanta and the therefore conditioned very large number of such element. For the motion of the alpha particle relatively to the lead from the Schroedinger equation a resonating-group equation is derived in integral form, and after incorporation of the correct boundary conditions the generated variational problem is solved, whereby line widths results which are by a factor 50 too small compared to the experiment. The above approach is improved by taking a Po compound state into account, whereby the nucleons above the Fermi edge of the lead are describe by two-by-two to the zero angular momentum coupled functions.

29790 (INIS-mf—8385) **Collective and one-body degrees of freedom in high spin states.** Lima, C.L. (Tuebingen Univ. (Germany, F.R.). Fakultaet fuer Physik). 15 Jul 1982. 111p. (In German). NTIS (US Sales Only), PC A06/MF A01. Order Number DE84780171.

In the first three chapters of the present thesis nuclei in the Pt-Hg region were studied by three different models, namely i) 2QP + rotor, ii) 2QP + IBA, iii) 2QP + coherent states (2QT + CS). As a general result it can be said that all three models were able to obtain good agreement with the experimental properties (energy spectra, transition probabilities, and g-factors) although the model 2QP + CS shows B(E2)-values for the transitions between states of the ground band ($I <= 8$), which are similar to a vibrator contrarily to the experimental results for this region. In the second part of this thesis the one-particle parameters of the Woods-Saxon potential were optimized in order to describe the high spin excitations of the spherical or oblately deformed nuclei in the immediate region of ^{140}Gd. The optimal parameter values, which had be obtained for the spin-orbit part of the potential, are almost the same for protons and neutrons.

29791 (LBL—16281, pp 301-304) **Asymmetric fission of relativistic gold nuclei.** Freier, P.S.; Waddington, C.J. (Univ. of Minnesota, Minneapolis). Dec 1983. NTIS, PC A99/MF A01. Order Number DE84005862. (CONF-830675—). TI84005862

From 6. high energy heavy ion study and 2. workshop on anomalons; Berkeley, CA, USA (28 Jun 1983).

Relativistic gold nuclei have been observed in nuclear emulsions. Among the nuclear interactions detected some 6.0% represent a fission of the projectile nucleus. One-third of these fission events have strongly asymmetric fission products while the other two-thirds are symmetric. This appears to be the first observation of a significant yield of asymmetric fission from nuclei in this mass range. 9 references.

29792 (LBL—16281, pp 317-320) **Neutron emission from collisions of 390 MeV/u neon ions on lead.** Madey, R.; Varga, J.C.; Anderson, B.D.; Baldwin, A.R.; Cecil, R.; Watson, J.W.; Westfall, G.D. (Kent State Univ., OH; Michigan State Univ., East Lansing). Dec 1983. NTIS, PC A99/MF A01. Order Number DE84005862. (CONF-830675—). TI84005862

From 6. high energy heavy ion study and 2. workshop on anomalons; Berkeley, CA, USA (28 Jun 1983).

We measured neutron time-of-flight spectra at eight angles (viz., 0°, 15°, 30°, 50°, 70°, 90°, 120°m and 160°) from collisions of neon ions with an energy of 390 MeV/u at the center of a (3.43 g/cm^2) Pb target. Flight paths ranged from 8 m at 0° to 3.5 m at 160°. The apparatus measured the time difference between the detection of a neon ion in a beam telescope (consisting of two 0.8 mm scintillators) and the detection of a neutron in one of the eight, mean-timed, neutron detectors. The neutron energy resolution varied from 4% at 100 MeV, to 8% at 400 MeV, to 15% at 800 MeV. Results are reported.

29793 (LBL—16281, pp 337-340) **Au target fragmentation at intermediate energies.** Aleklett, K.; Loveland, W.; McGaughey, P.L.; Moody, K.J.; McFarland, R.M.; Kraus, R.H. Jr.; Seaborg, G.T. Dec 1983. NTIS, PC A99/MF A01. Order Number DE84005862. (CONF-830675—). TI84005862

From 6. high energy heavy ion study and 2. workshop on anomalons; Berkeley, CA, USA (28 Jun 1983).

Target fragment yields were measured for the interaction of 12.0 and 18.4 MeV/u ^{16}O and 45.8 and 83.8 MeV/u ^{12}C with ^{197}Au.

29794 (LBL—16281, pp 567-573) **Fractional charge search at the Bevalac.** Shaw, G.L. (Univ. of California, Irvine). Dec 1983. NTIS, PC A99/MF A01. Order Number DE84005862. (CONF-830675—). TI84005862

From 6. high energy heavy ion study and 2. workshop on anomalons; Berkeley, CA, USA (28 Jun 1983).

The glow model of broken QCD allows for free, low-mass, fractionally charged, glow-singlet, color 6, diquarks Q. Although these composite Q's may be difficult to produce at present e^+e^- and hadronic energies, the situation could be much more favorable in heavy-ion collisions. In contrast to other models, the glow model allows for parameters which could lead to the production of fractional charge at Bevalac energies. A two stage experiment is in progress: The first step consisted of an (initial) exposure of a heavy target configuration to a total of 3 x 10^{10} Fe ions of 1.9 GeV/nucleon kinetic energy. Fractional charge which escaped the target was stopped in five gallon tanks of CCl_4 and collected (and thus concentrated) on thin central wires. The target materials and collection wires were distributed to a number of laboratories conducting experiments designed to look for free fractional charge in bulk matter. The first results from the SFSU automated Millikan droplet experiment found less than one fractional charge produced per 10^4 Fe-Pb collisions (and with further assumptions, less than one for 2 x 10^6 collisions). 14 references.

29795 (LBL—16281, pp 589-591) **Search for unstable superdense nuclei at the Dubna synchrophasotron.** Kuznetsov, A.A. (Joint Inst. for Nuclear Research, Dubna, USSR). Dec 1983. NTIS, PC A99/MF A01. Order Number DE84005862. (CONF-830675—). TI84005862

From 6. high energy heavy ion study and 2. workshop on anomalons; Berkeley, CA, USA (28 Jun 1983).

Experimental results are briefly discussed on a search for superdense nuclei unstable to β-decay for a lifetime of $10^{-8} \leqq$ tau $\leqq 10^{-6}$ s and metastable superdense nuclei decaying with π^0-meson emission for a lifetime of 10^{-7}-10^{-1} s. These experiments have been recently carried out at the synchrophasotron on beams of carbon relativistic nuclei. The momenta of the beam of ^{12}C nuclei extracted from the synchrophasotron were 1.68 and 4.5 GeV/c per nucleon. (WHK)

29796 **Obtaining of the high energy-resolution spectra of heavy-ion on a QQDQ magnetic spectrometer.** Chenglie, J.; Christensen, P.R.; Hansen, O.; Pontoppidan, S.; Videbaek, F.; Bond, P.D.; Shuell, D.; Freiesleben, H.; Wenqing, S.; Busch, F. (Institute of Atomic Energy, Academia Sinica, P.O. Box 275, Beijing). *Zhonghua Heyixue Zazhi;* **5**: No. 1, 27-35(Feb 1983). (In Chinese).

A high energy-resolution experiment of heavy ion nuclear reaction of $^{86}Kr + ^{208}Pb$ is done with the QQDQ magnetic spectrometer on GSI-UNILAC. This is the first time to accomplish a rather detail analysis of the energy spectra of outgoing ions from such heavy colliding system. Even a rather careful tuning of the running of the spectrometer is done, the horizontal position of the ion trajectory on the focal plane still somewhat depends on the entrance angle and the vertical position, thus influences the energy resolution. A method is suggested to remedy this distortion, the result is promising.

29797 **(INIS-BR—104) Cluster approach to intranuclear cascade for relativistic heavy ion collisions.** Kodama, T.; Duarte, S.B.; Chung, K.C. (Centro Brasileiro de Pesquisas Fisicas, Rio de Janeiro); Nazareth, R.A.M.S. (Rio de Janeiro Univ. (Brazil). Inst. de Fisica). (Centro Brasileiro de Pesquisas Fisicas, Rio de Janeiro). 1984. 13p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE84780172.

A new approach to the intranuclear cascade model for relativistic heavy ion reaction is presented. The effect of nucleon concentration on the collision process is explicitly included. It is found that the contributions from the non-binary processes are far from being negligible. Such processes are shown to broaden the angular distribution of inclusive proton spectra for $^{20}Ne + ^{238}U$ head-on collisions.

29798 (INIS-SU—198, pp 229) **Test of accuracy of high spins approximation in the coriolis interaction problem.** Brianson, Sh.; Mikhajlov, I.N.; Safarov, R.Kh.; Usmanov, F.N.; Yuldashbaeva, Eh.Kh. 1983. (In Russian). NTIS (US Sales Only), PC A99/MF A01. Order Number DE84780104. (CONF-8304144—Summs.). TI84780104

From 23. conference on nuclear spectroscopy and nuclear structure; Moscow, USSR (19 Apr 1983).

29799 (INIS-SU—198, pp 273) **Theory of a monopole transition of the ^{233}U nucleus (340 kev, $5/2^+ \rightarrow 5/2^+$).** Borisoglebskij, L.A.; Kats, F.V. 1983. (In Russian). NTIS (US Sales Only), PC A99/MF A01. Order Number DE84780104. (CONF-8304144—Summs.). TI84780104

From 23. conference on nuclear spectroscopy and nuclear structure; Moscow, USSR (19 Apr 1983).

29800 (INIS-SU—198, pp 275) **Effect of nonaxiality of a nucleus on muon conversion coefficients.** Borisogbskij, L.A.; Tesevich, B.I. 1983. (In Russian). NTIS (US Sales Only), PC A99/MF A01. Order Number DE84780104. (CONF-8304144—Summs.). TI84780104

From 23. conference on nuclear spectroscopy and nuclear structure; Moscow, USSR (19 Apr 1983).

29801 (INIS-SU—198, pp 307) **Lifetime of ^{236}U and ^{239}U compound nuclei and determination of statistical calculation parameters.** Karamyan, S.A. 1983. (In Russian). NTIS (US Sales Only), PC A99/MF A01. Order Number DE84780104. (CONF-8304144—Summs.). TI84780104

From 23. conference on nuclear spectroscopy and nuclear structure; Moscow, USSR (19 Apr 1983).

29802 (INIS-SU—198, pp 486) **Structure exclusion for heavy fragmentation of atomic nucleWs.** Smirnov, Yu.F.; Chuvil'skij, Yu.M. 1983. (In Russian). NTIS (US Sales Only), PC A99/MF A01. Order Number DE84780104. (CONF-8304144—Summs.). TI84780104

From 23. conference on nuclear spectroscopy and nuclear structure; Moscow, USSR (19 Apr 1983).

29803 **Accomplishments and promise of transplutonium research.** Keller, O.L. Jr.; Hoffman, D.C.; Penneman, R.A.; Choppin, G.R. (Oak Ridge National Laboratory). *Physics Today;* **37**: No. 3, 35-43(Mar 1984). Contract FG01-81ER10984.

The 16 new elements added to the periodic table beyond uranium not only have contributed to our understanding of nuclear and atomic physics, but some have practical uses as well.

6530 Nuclear Theory

REFER ALSO TO CITATION(S) 29649, 29674, 29691, 29763, 29776, 29777, 29781, 29790

29804 **(CEA-CONF—6910) Dissipative phenomena: fusion, fast fission and quasifission.** Ngo, C. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France)). Sep 1983. 23p. (CONF-830833—20). NTIS (US Sales Only), PC A02/MF A01. Order Number DE84750623.

From International conference on nuclear physics; Florence, Italy (29 Aug 1983).

The last theoretical developments concerning the fusion process are reviewed. They concern the appearance of new dissipative mechanisms: fast fission, when the fission barrier of the compound nucleus vanishes due to angular momentum, and quasifission which takes place for heavy systems. The conditions under which these processes, as well as fusion, occur are discussed in details using the fast fission and the extra push models.

29805 **(CEA-CONF—6972) Electron scattering and nuclear structure.** Frois, B. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France)). Sep 1983. 13p. (CONF-830833—21). NTIS (US Sales Only), PC A02/MF A01. Order Number DE84750627.

From International conference on nuclear physics; Florence, Italy (29 Aug 1983).

Portions are illegible in microfiche products.

Electron scattering is a remarkable source of quantitative and interpretable data on nuclear structure. The nuclear charge and magnetization densities can be determined in great detail, giving the spatial distribution of the nucleons in the innermost region of the

nucleus. A review of the recent results chosen for their illustrative value is given.

29806 **(CEA-CONF—6974) Pions, delta's and quarks in nuclei.** Laget, J.M. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France)). Oct 1983. 10p. (CONF-8309204—1). NTIS (US Sales Only), PC A02/MF A01. Order Number DE84750626.

From INS symposium on high energy photonuclear reactions and related topics; Tokyo, Japan (29 Sep 1983).

Nuclear Physics has now evolved from the study of the many nucleon problem, to the study of the interplay of the degrees of freedom of such a complex system and the internal degrees of freedom of each of its hadronic constituents. Extensive studies of electronuclear reactions have all allowed us to disentangle the basic mechanisms of the interaction between two baryons in a nucleus. The pion exchange mechanisms, which dominates at large distance has been singled out. The NΔ interaction, which enter the description of the intermediate range part, has been studied. Evidences for effects due to the quark structure of the nucleon have been found. But more systematic studies are needed to study them in detail.

29807 (DESY-HERA—83/20, pp 55-84) **Nuclear effects in deep inelastic scattering.** Llewellyn Smith, C.H. Oct 1983. NTIS (US Sales Only), PC A24/MF A01. Order Number DE84751338. (CONF-8306156—). TI84751338

From Workshop on experimentation at HERA; Amsterdam, Netherlands (9 Jun 1983).

I shall discuss physics which cannot be studied with ep colliders although it may be relevant for the ep programme. Most of my talk is devoted to the striking difference between the structure functions of iron and deuterium recently reported by the European Muon Collaboration (EMC). I also describe briefly how the questions of shadowing and the evolution of leptoproduced jets in nuclei appear to a non-expert.

29808 **(INIS-mf—8348) Expansion of the fireball after a high energetic heavy ion reaction.** Aichelin, J. (Heidelberg Univ. (Germany, F.R.). Naturwissenschaftlich-Mathematische Gesamtfakultaet). 1982. 82p. (In German). NTIS (US Sales Only), PC A05/MF A01. Order Number DE84780173.

Employing the Wigner density formalism we present a model for the expansion of a fireball created in a relativistic heavy ion collision In a simplified model we first study how many collisions a nucleon suffers during the expansion. Knowing this we can determine the Wigner densities of the nucleons in the entrance channel of the elementary deuteron production. It turns out that, even if the nucleons in the entrance channel have a thermal distribution, the particles in the exit channel have not. The comparison with experiments shows that the energy distributions of pions, protons and deuterons can be described by the same temperature. The number of deuterons allows to determine the average density at the beginning of the expansion. Finally we compare these results with those of other models, especially of a chemical rate equation.

29809 (INIS-SU—189, pp 3-9) **Fission energy of uranium isotopes and transuranium elements.** Nemirovskij, P.Eh.; Manevich, L.G. 1981. (In Russian). NTIS (US Sales Only), PC A04/MF A01. Order Number DE84780170. TI84780170

In Nuclear constants.

A comparison is made between the prompt fission energy, Esub(pr), calculated from the mass and binding energy spectrum and the Esub(pr) value obtained from the experimental data on the kinetic energy of fragments, the energy of prompt neutrons and prompt γ-quanta. Basing on the data on β-decay chains of fission fragments, the energies of neutrinos, γ-quanta and β-electrons are obtained, which permits to calculate the actual energy released during fission. The calculations are performed for thermal neutron-induced fission, fast-neutron induced fission and for fission after bombardment with 14 MeV neutrons. The available experimental data on the fission fragment kinetic energy, prompt γ-quanta energy and fission neutron energy are presented. The comparison of the Esub(pr) values obtained experimentally for the thermal-neutron-induced fission with the calculated Esub(pr) value shows that for ^{233}U, ^{239}Pu, ^{241}Pu the agreement is rather favourable. For ^{235}U the agreement is within the error limits. As to the Esub(pr) values for the fast-neutron-induced fission, the agreement between the calculated and experimental data for all nuclides is quite good.

29810 (INIS-SU—198, pp 160) **Boson model with SU(3) symmetry as a simplified variant of symplectic collective model.** Smirnov, Yu.F.; Tolsto , V.N. 1983. (In Russian). NTIS (US Sales Only), PC A99/MF A01. Order Number DE84780104. (CONF-8304144—Summs.). TI84780104

From 23. conference on nuclear spectroscopy and nuclear structure; Moscow, USSR (19 Apr 1983).

29811 (INIS-SU—198, pp 165) **Nonlocal NN interaction by hyperspheric function method.** Bursak, A.V.; Gorbatov, A.M.; Krylov, Yu.N.; Rudyak, B.V. 1983. (In Russian). NTIS (US Sales Only), PC A99/MF A01. Order Number DE84780104. (CONF-8304144—Summs.). TI84780104

From 23. conference on nuclear spectroscopy and nuclear structure; Moscow, USSR (19 Apr 1983).

NONE

29812 (INIS-SU—198, pp 171) **Correlation coulomb energy of nuclear matter.** Shaginyan, V.P. 1983. (In Russian). NTIS (US Sales Only), PC A99/MF A01. Order Number DE84780104. (CONF-8304144—SUMMS.). TI84780104

From 23. conference on nuclear spectroscopy and nuclear structure; Moscow, USSR (19 Apr 1983).

29813 (INIS-SU—198, pp 204) **Mass difference jump in magic nuclei in the wigner scheme of SU(4) symmetry.** Vladimirov, D.M.; Gaponov, Yu.V.; Shul'Gina, N.B. 1983. (In Russian). NTIS (US Sales Only), PC A99/MF A01. Order Number DE84780104. (CONF-8304144—SUMMS.). TI84780104

From 23. conference on nuclear spectroscopy and nuclear structure; Moscow, USSR (19 Apr 1983).

29814 (INIS-SU—198, pp 220) **Spin-orbital nuclear interaction in a nuclear system.** Korolev, A.M. 1983. (In Russian). NTIS (US Sales Only), PC A99/MF A01. Order Number DE84780104. (CONF-8304144—Summs.). TI84780104

From 23. conference on nuclear spectroscopy and nuclear structure; Moscow, USSR (19 Apr 1983).

29815 (INIS-SU—198, pp 224) **Nonequivalency of three-particle and two-particle forces depending on density.** Krutov, V.A.; Krutova, L.A. 1983. (In Russian). NTIS (US Sales Only), PC A99/MF A01. Order Number DE84780104. (CONF-8304144—Summs.). TI84780104

From 23. conference on nuclear spectroscopy and nuclear structure; Moscow, USSR (19 Apr 1983).

29816 (INIS-SU—198, pp 228) **Study on the rotational bands in the model of phase random approximation plus self-consistent cranking model.** Kvasil, Ya.; Mikhajlov, I.N.; Tsvek, S.; Chariev, M.M.; ChorieV, B. 1983. (In Russian). NTIS (US Sales Only), PC A99/MF A01. Order Number DE84780104. (CONF-8304144—Summs.). TI84780104

From 23. conference on nuclear spectroscopy and nuclear structure; Moscow, USSR (19 Apr 1983).

29817 (INIS-SU—198, pp 274) **Internal conversion coefficients in atoms with a nonstable electron configuration.** Kuzhir, P.G.; Shulyakovskij, G.S. 1983. (In Russian). NTIS (US Sales Only), PC A99/MF A01. Order Number DE84780104. (CONF-8304144—Summs.). TI84780104

From 23. conference on nuclear spectroscopy and nuclear structure; Moscow, USSR (19 Apr 1983).

29818 (INIS-SU—198, pp 280) **Integral characteristics of polarized bremsstrahlung with account for recoil effects and nuclear structure.** Nadzhafov, I.M.; Rustamova, G.R. 1983. (In Russian). NTIS (US Sales Only), PC A99/MF A01. Order Number DE84780104. (CONF-8304144—Summs.). TI84780104

From 23. conference on nuclear spectroscopy and nuclear structure; Moscow, USSR (19 Apr 1983).

29819 (INIS-SU—198, pp 447) **Matrix elements of channel coupling in a problem of nucleon scattering by nonaxial "soft" nuclei.** Kashuba, I.E.; Sukhovitskij, E.Sh.; Kostyuk, T.A. 1983. (In Russian). NTIS (US Sales Only), PC A99/MF A01. Order Number DE84780104. (CONF-8304144—Summs.). TI84780104

From 23. conference on nuclear spectroscopy and nuclear structure; Moscow, USSR (19 Apr 1983).

29820 (INIS-SU—198, pp 461) **Restriction on resonance parameters in the presence of background coherent reaction channels.** Kangrapol', Yu.V. 1983. (In Russian). NTIS (US Sales Only), PC A99/MF A01. Order Number DE84780104. (CONF-8304144—Summs.). TI84780104

From 23. conference on nuclear spectroscopy and nuclear structure; Moscow, USSR (19 Apr 1983).

29821 (INIS-SU—198, pp 482) **Fission cross sections and potential of heavy ion interaction.** Baznat, M.I.; Gudima, K.K. 1983. (In Russian). NTIS (US Sales Only), PC A99/MF A01. Order Number DE84780104. (CONF-8304144—Summs.). TI84780104

From 23. conference on nuclear spectroscopy and nuclear structure; Moscow, USSR (19 Apr 1983).

29822 **(JINR—E-2-83-101) Coalescence model apd the Pauli quenching in high-energy heavy-ion collisions.** Gudima, K.K.; Ropke, G.; Schulz, H.; Toneev, V.D. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1983. 5p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE84701691.

A composite particle production mechanism is discussed for high-energy heavy-ion collisions. It is shown that the effective account of the nuclear medium on the deuteron-like bound-state wave function by solving a Bethe-Goldstone type equation requires a smaller coalescence radius of the respective momentum space compared with that obtained by using a deuteron wave function of two isolated nucleons. Calculating the proton and deuteron spectra of relativistic heavy-ion reactions in the framework of the cascade model gives values of the coalescence of nucleons in accordance with these expectations.

29823 **(JINR—E-2-83-415) Quark-parton structure functions of nuclei.** Baldin, A.M. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy). 1983. 8p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE84701692.

The previously available and new experimental data are used to discuss the properties of the structure functions of nuclei as independent (irreducible to one-nucleon) objects of hadron physics. The basic data have been obtained by the Stavinsky group in experiments on limiting fragmentation of more than 20 nuclei from ^{7}Li to ^{238}U. The discovered properties of the quark-parton structure functions give evidence for the existence in nuclei of multiquark configurations which essentially differ from those present in both free nucleons and two-, three- and more nucleon systems. Experiments on deep inelastic scattering of leptons on nuclei performed by the CERN-Dubna NA-4 Collaboration, the European Muon Collaboration and at SLAC confirm the conclusions about the structure functions of nuclei drawn from nuclear limiting fragmentation studies.

29824 **(JINR—E-4-83-421) Interacting vector boson model of collective nuclear states. Tensorial structure of the Hamiltonian.** Georgieva, A.I.; Rachev, P.P.; Roussev, R.P. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1983. 20p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE84701693.

The most general one- and two-body interaction is constructed by means of two interacting vector bosons. The group U(6) is the group of dynamical symmetry if the Hamiltonian conserves the number of bosons. All possible types of one- and two-boson interactions are expressed by irreducible tensor operators corresponding to the decomposition: U(6) is contained in U(3)+U(2) is contained in U(3)+(U(1)+U(1)) is contained in O(3). The necessary isoscalar factors are calculated. This representation of the Hamiltonian makes possible its diagonalization through a direct application of the Wigner-Eckart theorem.

29825 **(KFK—3556) Nuclear densities of 1fsub(7/2) nuclei from elastic alpha-particle scattering.** Friedman, E.; Gils, H.J.; Rebel, H. (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Inst. fuer Kernphysik). Dec 1983. 60p. NTIS (US Sales Only), PC A04/MF A01. Order Number DE84751304.

The elastic scattering of 104 MeV α particles by sup(40,42,43,44,48)Ca, ^{50}Ti, ^{51}V, ^{52}Cr has been analyzed by phenomenological and semimicroscopic optical potentials in order to get information on isotopic and isotonic differences of the α particle optical potentials and of nuclear matter densities. The phenomenological optical potentials based on a Fourier-Bessel description of the real part reveal different behaviour in size and shape for the isotonic chain as compared to the isotopic chain. Odd-even effects are also indicated to be different for isotones and isotopes. The semimicroscopic analyses use a single-folding model with a density-dependent effective αN-interaction including a realistic local density approximation. The calculated potentials are fully consistent with the phenomenological ones. Isopotic and isotonic differences of the nuclear matter densities obtained from the folding model in general show a similar behavior as the optical potential differences. The results on matter densities are compared to other investigations.

29826 (LBL—16281, pp 97-110) **Is the anomalon a dinotor.** Castillejo, L.; Goldhaber, A.S.; Jackson, A.D.; Johnson, M.B. (University College London, England; State Univ. of New York, Stony Brook; LAMPF, Los Alamos, NM). Dec 1983. NTIS, PC A99/MF A01. Order Number DE84005862. (CONF-830675—). TI84005862

From 6. high energy heavy ion study and 2. workshop on anomalons; Berkeley, CA, USA (28 Jun 1983).

A model is proposed to explain the anomalous fragments in high energy heavy ion collisions. It consists of a large toroidal bag containing a Fermi sea of quarks confined by the M.I.T. bag boundary condition. Its shape, stability and lifetime are discussed as are the effects of one gluon exchange in determining the internal quark wave functions.

29827 (LBL—16281, pp 111-147) **Spontaneously broken symmetries in nuclear physics.** Boguta, J. Dec 1983. NTIS, PC A99/MF A01. Order Number DE84005862. (CONF-830675—). TI84005862

From 6. high energy heavy ion study and 2. workshop on anomalons; Berkeley, CA, USA (28 Jun 1983).

The purpose of this work is to explore the consequences of spontaneously broken symmetries in nuclear physics. This might seem an odd task to undertake in that spontaneously broken symmetries have played no substantial role in understanding nuclear structure. It becomes meaningful, though, in a field theoretic description of nuclear interactions. There are two types of spontaneously broken symmetries that are relevant in a relativistic field theory approach to nuclear structure and nuclear dynamics. The pion plays an important role in both. It can be viewed as the realization of chiral symmetry in the Goldstone mode. T.D. Lee and G.C. Wick showed a number of years ago that such realization of chiral symmetry implies the existence of a new solution to the field equations, leading to a new nuclear configuration. The other form of spontaneously broken symmetry that is relevant is gauge invariance. The consideration of spontaneously broken gauge field theory in the context of nuclear physics is a logical consequence of the relativistic field theory program, initiated by J.D. Walecka, to describe nuclear interactions. 18 references.

29828 (LBL—16281, pp 149-165) **Quasi-molecular structures in nuclear systems.** Tang, Y.C. (Univ. of Minnesota, Minneapolis). Dec 1983. NTIS, PC A99/MF A01. Order Number DE84005862. (CONF-830675—). TI84005862

From 6. high energy heavy ion study and 2. workshop on anomalons; Berkeley, CA, USA (28 Jun 1983).

Theoretical and/or experimental evidence is presented to show that there exist quasi-molecular structures in light, medium, and heavy systems. At relativistic energies, an impulse mechanism, which can effectively excite the quasi-molecular states, is described. Plausible arguments are given, which suggest that the observation of anomalons and the asymmetric fission in the Au-region may both be related to the existence of quasi-molecular structures in nuclei. 34 references.

29829 (LBL—16281, pp 167-168) **Anomalous nuclei and a nonstatic metastable σ-tau phase.** Palumbo, F. (Laboratori Nazionali di Frascati, Italy). Dec 1983. NTIS, PC A99/MF A01. Order Number DE84005862. (CONF-830675—). TI84005862

From 6. high energy heavy ion study and 2. workshop on anomalons; Berkeley, CA, USA (28 Jun 1983).

Recent experiments have confirmed previous observations of light anomalous nuclei. These nuclei are characterized by a lifetime of at least 10^{-11} s and by a cross-section which exceeds the geometrical bound by one order of magnitude. A cross-section exceeding the geometrical bound is something so extraordinary that it seems to us to be worthwhile considering any mechanism which could possibly explain it, even if an explicit calculation is not possible at present. We, therefore, make here some qualitative considerations relating such cross-sections to a possible metastable σ-tau phase (spin-up protons and spin-down neutrons displaced with respect to spin-down protons and spin-up neutrons).

29830 (LBL—16281, pp 169-172) **Pion condensates as anomalons.** Fowler, G.N.; Raha, S.; Weiner, R.M. (Univ. of Marburg, W. Germany; Univ. of Exeter, England). Dec 1983. NTIS, PC A99/MF A01. Order Number DE84005862. (CONF-830675—). TI84005862

From 6. high energy heavy ion study and 2. workshop on anomalons; Berkeley, CA, USA (28 Jun 1983).

We propose a solution to the anomalon problem in terms of another phenomenon which has been studied intensively and for which there exists an appreciable consensus that it should occur in nuclear matter under appropriate conditions; we refer to pion condensates. The pion field outside a nucleus in which a condensate exists can have a much longer range than the pion field outside a normal nucleus. It is this longer range which determines the scattering cross section of the nuclear fragment. Physically this enhancement comes about because the change in the vacuum state characteristic of nuclei with pion condensates continues for some distance outside the nucleus. As a theoretical description of pion condensates, we use, as customary, the chiral σ model with spontaneous symmetry breaking.

29831 (LBL—16281, pp 173-176) **Nuclear chromodynamics and "anomalons".** Kim, Y.E.; Orlowski, M. (Purdue Univ., West Lafayette, IN). Dec 1983. NTIS, PC A99/MF A01. Order Number DE84005862. (CONF-830675—). TI84005862

From 6. high energy heavy ion study and 2. workshop on anomalons; Berkeley, CA, USA (28 Jun 1983).

We propose a new theoretical explanation of anomalons based on a unified theory of nuclear chromodynamics formulated recently by us. 12 references.

29832 (LBL—16281, pp 177-180) **Some anomalon phenomenology.** Watson, P.J.S. (S.I.N., Villigen, Switzerland). Dec 1983. NTIS, PC A99/MF A01. Order Number DE84005862. (CONF-830675—). TI84005862

From 6. high energy heavy ion study and 2. workshop on anomalons; Berkeley, CA, USA (28 Jun 1983).

Some unknowns about anomalons are listed and discussed. These unknowns include mass difference from nearest normal state, lifetime, decay mode, reason for enhanced cross section, production in light ion collisions, charge states, Z-dependence of cross sections, associated production, and nuclear excitation or elementary particle. (WHK)

29833 (LBL—16281, pp 185-187) **Are "anomalons" a bag ful'o colorful nucleons.** Kruse, F.; Noack, C.C. (Univ. Bremen, W. Germany). Dec 1983. NTIS, PC A99/MF A01. Order Number DE84005862. (CONF-830675—). TI84005862

From 6. high energy heavy ion study and 2. workshop on anomalons; Berkeley, CA, USA (28 Jun 1983).

One of the more intriguing explanations of the possible existence of "anomalons" (if they do exist) would seem to be in terms of internal color excitations of nuclei. While it follows from confinement in QCD that isolated nuclei (as well as isolated nucleons) must be in color singlet states, the same is not necessarily so for nucleons bound together in a small region of space, viz. a nucleus. Thus one can envisage a nucleus in a color-excited state as composed of localized 3q-systems (i.e. nucleons) which, however, are not all color singlets. We have investigated a particularly simple example of such a model which retains as many of the features of "normal" nuclei as possible, and at the same time stays close to the physical picture of the M.I.T. bag model. We call this a "nuclear bag."

29834 (LBL—16281, pp 209-223) **Evidence on the equation of state of nuclear matter at high densities.** Harris, J.W.; Bangert, D.; Bock, R.; Brockmann, R.; Dacal, A.; Maier, M.; Odyniec, G.; Ortiz, M.E.; Pugh, H.G.; Rauch, W. (Gesellschaft fuer Schwerionenforschung, Darmstadt, W. Germany; Lawrence Berkeley Lab., CA). Dec 1983. NTIS, PC A99/MF A01. Order Number DE84005862. (CONF-830675—). TI84005862

From 6. high energy heavy ion study and 2. workshop on anomalons; Berkeley, CA, USA (28 Jun 1983).

Evidence is presented that supports the idea that the pion multiplicity [n/sub π^-/] reflects the maximum density attained in central relativistic nucleus-nucleus collisions. A comparison of the [n/sub π^-] data with predictions of vastly different models (hadrochemical, hydrodynamical, fireball, and cascade) suggests the presence of high-density nuclear matter. A systematic discrepancy between the observed [n/sub π^-] and those predicted in the cascade model correlates with the predicted density increase and anticorrelates with incident energy. This latter observation argues against "exotic" multinucleon pion absorption. Removing energy from the pion-producing degrees of freedom at high densities into potential degrees of freedom, excluded from the cascade model, explains these observations. Disregarding higher order corrections and simply associating this excess energy with the compressional energy, a parabolic nuclear matter equation of state is derived with a compressibility constant K = 240 MeV. Furthermore, the present analysis suggests that for ^{40}Ar + KCl collisions no more than one-third of the available cm energy can be associated with the compressional energy that would manifest itself as collective flow. However, the tremendous overestimate of the cascade model for the [n/sub π^-/] of ^{139}La results in approximately one-half of the cm energy going into compressional energy, neglecting other potential degrees of freedom. Thus the magnitude of the compressional energy may be approaching that of the chaotic thermal energy, and searches for collective effects may become feasible for heavier systems. 26 references.

29835 (LBL—16281, pp 241-249) **Current status of high energy cascade models.** Remler, E.A. (College of William and Mary, Williamsburg, VA). Dec 1983. NTIS, PC A99/MF A01. Order Number DE84005862. (CONF-830675—). TI84005862

From 6. high energy heavy ion study and 2. workshop on anomalons; Berkeley, CA, USA (28 Jun 1983).

The cascade model is described on a kind of map of theories. That is, its status is described relative to other approximations to Quantum Mechanics. In addition an explanation for why the area near it in theory space is worth further exploration is given. Finally the current status of such explorations is described. 7 references.

29836 (LBL—16281, pp 251-254) **Scaling properties in the hydrodynamical description of nucleus nucleus collisions at intermediate energies.** Balazs, N.L.; Schuermann, B.; Dietrich, K.; Csernai, L.P. (State Univ. of New York, Stony Brook; Technischen Univ., Muenchen, Garching, W. Germany; Central Research Inst. for Physics, Budapest, Hungary). Dec 1983. NTIS, PC A99/MF A01. Order Number DE84005862. (CONF-830675—). TI84005862

From 6. high energy heavy ion study and 2. workshop on anomalons; Berkeley, CA, USA (28 Jun 1983).

Simple scaling properties of heavy ion reactions at intermediate energies are discussed which follow from the hydrodynamical equations. The measured as well as the calculated hydrodynamical inclusive cross sections exhibit scaling in certain kinematical regions. The fireball model obeys the same scaling laws, but leads to a differential cross section with a qualitatively different shape. The experimental data we analyzed did not show evidence for a hydrodynamical flow.

29837 (LBL—16281, pp 263-289) **Critical phenomena at low temperature.** Scott, D.K. (Michigan State Univ., East Lansing). Dec 1983. NTIS, PC A99/MF A01. Order Number DE84005862. (CONF-830675—). TI84005862

From 6. high energy heavy ion study and 2. workshop on anomalons; Berkeley, CA, USA (28 Jun 1983).

Critical phenomena in high energy heavy ion collisions have long been of interest in view of the possibility of creating new states of nuclear matter in the form of a pion condensate, density isomer, and quark-gluon plasma. In this paper we discuss critical phenomena which may be relevant at much lower densities and temperatures. Instabilities associated with a liquid-gas phase transition and a nuclear break-up when the compressibility becomes negative are discussed. Although the phenomena are less exotic than those conjectured to occur at high density or temperature, they also rely for their evolution on a hydrodynamical description of nuclear collisions. Questions of time scales, which are important for all types of critical phenomena, are touched upon. Some of the possible experimental signatures, along with present evidence, for the onset of critical behavior are described. A discussion of more general implications of the behavior of the nuclear equation of state at low density and temperature is included. Low temperature critical phenomena have implications on topics as diverse as the nuclear mean free path, anomalons, and the evolution of supernovae. 54 references.

29838 (LBL—16281, pp 291-294) **High energy (30-350 GeV) proton-nucleus collisions and the description of fragmentation as a critical phenomenon.** Hirsch, A.S.; Bujak, A.; Finn, J.E.; Gutay, L.J.; Minich, R.W.; Porile, N.T.; Scharenberg, R.P.; Stringfellow, B.C.; Turkot, F. (Purdue Univ., Lafayette, IN; Fermi National Accelerator Lab., Batavia, IL). Dec 1983. NTIS, PC A99/MF A01. Order Number DE84005862. (CONF-830675—). TI84005862

From 6. high energy heavy ion study and 2. workshop on anomalons; Berkeley, CA, USA (28 Jun 1983).

The power law behavior of the fragment yield from high energy proton-nucleus collisions with heavy nuclear targets suggests that fragmentation may be a critical phenomenon. Parameterizing the fragment Helmholtz free energy in a form resembling the Weizsaecker mass formula has enabled us to fit simultaneously all of the observed fragment yields from a given target. We estimate that the critical temperature for a heavy nucleus is about 3-5 MeV. The high energy tails of the fragment kinetic energy spectra provide evidence that all of the observed fragments are created at the same time from a common system. The tails appear to be dominated by the mean-squared momentum of the nucleon in this system, i.e., Fermi motion. Small Coulomb energies arise naturally in this description since the entire remnant system undergoes disassembly simultaneously. 14 references.

29839 (LBL—16281, pp 341-344) **Phase-space constraints on the momenta of projectile fragments.** Murphy, M.J. (Univ. of Washington, Seattle). Dec 1983. NTIS, PC A99/MF A01. Order Number DE84005862. (CONF-830675—). TI84005862

From 6. high energy heavy ion study and 2. workshop on anomalons; Berkeley, CA, USA (28 Jun 1983).

The model of projectile fragmentation as a fast reaction which samples the nucleon Fermi momenta in the projectile prior to the collision is revised to reflect the fact that the fragment is also a Fermi gas. The results predict fragment momentum distributions which are narrower than those observed.

29840 (LBL—16281, pp 349-352) **Subthreshold pion production in nucleus-nucleus collisions - a co-operative process.** Shyam, R.; Knoll, J. (Gesellschaft fuer Schwerionenforschung, Darmstadt, W. Germany). Dec 1983. NTIS, PC A99/MF A01. Order Number DE84005862. (CONF-830675—). TI84005862

From 6. high energy heavy ion study and 2. workshop on anomalons; Berkeley, CA, USA (28 Jun 1983).

Significant pion production cross-sections have been observed in the collision of two nuclei at the beam energies (<290 MeV/A) where the basic nucleon-nucleon collision cannot produce a pion. The earliest suggestion to understand this process dates back to Fermi. It exploits the fact that the initial intrinsic nucleonic motion offers the necessary extra boost for the elementary nucleon-nucleon (N-N) pion production process. This original idea has recently been reconsidered in a "first N-N collision" model for a quantitative explanation of the pion production at beam energies both below and above threshold. However, with decreasing beam energy this model may become insufficient to explain the production rates as well as the shapes of the pion spectra. Other mechanisms like participation of more than two nucleons into the pion production process and the freezing of the degrees of freedom in the final channel, i.e., formation of the composite nuclei may become increasingly important. Near the absolute threshold (minimum beam energy/nucleon required to produce a pion in the nucleus-nucleus collision), the mechanism of "pionic fusion" in which two nuclei as a whole coherently interact with each other and fuse to form a compound nucleus, converting all the available free energy into a pion, becomes the only possible production mechanism. Before attempting to achieve a detailed microscopic description of the subthreshold pion production process, it is essential to understand clearly the bare kinematical implications of the alternative pion production mechanisms. In particular we carefully rediscuss the single nucleon-nucleon collision mechanism.

29841 (LBL—16281, pp 353-355) **Pion production from peripheral heavy-ion collisions through coherent isobar and isobaric analog giant resonance formation.** Deutchman, P.A.; Madigan, R.L.; Norbury, J.W.; Townsend, L.W. (Univ. of Idaho, Moscow). Dec 1983. NTIS, PC A99/MF A01. Order Number DE84005862. (CONF-830675—). TI84005862

From 6. high energy heavy ion study and 2. workshop on anomalons; Berkeley, CA, USA (28 Jun 1983).

A spin, isobaric-spin formalism for the coherent production of isobars in the peripheral region of a high-energy heavy-ion projectile along with giant isobaric analog excitations has been improved and extended. These changes include the decay of the nucleonic isobars to pions and the removal of the classical straight line assumption along with generalization of the density of states to four bodies. Formal expressions for the total and a differential cross section for pion angular distributions have been obtained.

29842 (LBL—16281, pp 405-408) **Deep inelastic lepton scattering and the quark structure of nuclei.** Vary, J.P.; Pirner, H.J. (Iowa State Univ., Ames; Universitaet Heidelberg, W. Germany). Dec 1983. NTIS, PC A99/MF A01. Order Number DE84005862. (CONF-830675—). Contract AC02-82ER40068. TI84005862

From 6. high energy heavy ion study and 2. workshop on anomalons; Berkeley, CA, USA (28 Jun 1983).

Deep inelastic lepton scattering has proven to be a powerful tool for discovering the substructure of the hadrons. In the same way, we expect that deep inelastic scattering (DIS) from nuclei reveals how that substructure is modified by the nuclear medium. We have presented a model which successfully explained DIS on ^{3}He in terms of 3, 6, and 9-quark clusters. We have recently improved the model by incorporating more realistic nuclear wave functions to determine the effects of Fermi motion and to evaluate the geometrical overlap probabilities of cluster formation. Furthermore, we

have included the contributions of sea quarks which are important for understanding the new data with iron targets. We have also extended the model to obtain a description of the elastic charge form factor of ^{3}He. Here, we summarize the principal ingredients of the model and present illustrative results for DIS. 12 references.

29843 (LBL—16281, pp 409-412) **Anomalous behaviour of nuclear structure functions revisited.** Furmanski, W.; Krzywicki, A. (Univ. Paris-Sud, Orsay, France). Dec 1983. NTIS, PC A99/MF A01. Order Number DE84005862. (CONF-830675—). TI84005862

From 6. high energy heavy ion study and 2. workshop on anomalons; Berkeley, CA, USA (28 Jun 1983).

If a nucleus is regarded as a collection of quasi-free nucleons, the nuclear structure functions are simply proportional to the corresponding structure functions of the nucleon. It has been argued that the conventional picture of the nucleus might not hold when the nucleus is probed during a very short time. A simple parton model has been formulated, illustrating the idea of an anomalous behaviour of nuclear structure functions. The nucleus is pictured as one bag of partons. (WHK)

29844 (LBL—16281, pp 413-425) **Stopping process of GeV particles in target nuclei.** Nakai, K. (Univ. of Tokyo, Hongo, Japan). Dec 1983. NTIS, PC A99/MF A01. Order Number DE84005862. (CONF-830675—). TI84005862

From 6. high energy heavy ion study and 2. workshop on anomalons; Berkeley, CA, USA (28 Jun 1983).

The issue of whether and how we can produce high energy densities in nuclear matter is one of central subjects in high energy nuclear reaction studies. Theoretical speculations for possible phenomena associated with nuclear matter at high baryon densities or high energy densities stimulated experimental efforts to study high-energy heavy-ion reactions at Bevalac. However, we don't know yet what would be the best energy for generation of high energy densities. Obviously, one needs nucleus-nucleus collisions at high energies, but at higher energies nuclei would become transparent, so that there must be an optimum energy for this purpose. It is, therefore, very important to study the nuclear stopping process and mechanisms of energy deposition of GeV particles in target nuclei. In order to survey the energy region above the Bevalac, we started experimental programs at KEK to study hadron-nucleus interactions in a few GeV regions. The stopping process of GeV particles is discussed based mainly on our experimental results.

29845 (LBL—16281, pp 433-445) **Hydrodynamical aspects of ultrarelativistic heavy ion collisions.** Ruuskanen, P.V. (Univ. of Jyvaeskylae, Finland). Dec 1983. NTIS, PC A99/MF A01. Order Number DE84005862. (CONF-830675—). TI84005862

From 6. high energy heavy ion study and 2. workshop on anomalons; Berkeley, CA, USA (28 Jun 1983).

Hydrodynamics with source terms is used to describe the space-time behaviour of hadronic matter produced in ultrarelativistic heavy ion collisions. Resulting energy density in the Central Region (CR) appears to be high enough for the formation of quark-gluon plasma, but the life-time of the plasma (if produced) is very short. In Fragmentation Regions (FR) the energy densities are probably too low for the formation of QCD-plasma. 21 references.

29846 (LBL—16281, pp 447-454) **Transverse expansion at central rapidities in ultra-relativistic heavy ion collisions.** Baym, G. (Univ. of Illinois, Urbana). Dec 1983. NTIS, PC A99/MF A01. Order Number DE84005862. (CONF-830675—). TI84005862

From 6. high energy heavy ion study and 2. workshop on anomalons; Berkeley, CA, USA (28 Jun 1983).

This talk describes the transverse hydrodynamic expansion of the central rapidity regime in a central ultra-relativistic heavy ion collision. The hydrodynamic equations, and numerical and analytic solutions for the expansion are presented. The formation of a "condensation discontinuity" in the dynamical phase transition from a quark-gluon plasma to hadronic matter, and the final freezeout to free-standing hadrons, are also briefly discussed. 10 references.

29847 (LBL—16281, pp 455-457) **Shock fronts without thermalization in ultrarelativistic heavy-ion reactions.** Csernai, L.P. (Central Research Inst. for Physics, Budapest, Hungary). Dec 1983. NTIS, PC A99/MF A01. Order Number DE84005862. (CONF-830675—). TI84005862

From 6. high energy heavy ion study and 2. workshop on anomalons; Berkeley, CA, USA (28 Jun 1983).

If we study a heavy-ion reaction at ultrarelativistic energies $E > 10$ GeV/nucleon, in lab. frame the collision proceeds as follows: (1): The Lorentz contracted projectile passes through the target with almost the speed of light. Since the N-N cross section is very much forward peaked, we assume that the two heavy-ions penetrate through each other with very small momentum loss and only a minor part of the initial kinetic energy will be thermalized inside the projectile of target remnants. Our aim is to describe the target and projectile fragmentation regions in a simple model. It is assumed that the Lorentz contracted projectile in the target frame can be represented as a shock front which, however, contrary to the ordinary compression shock (CS) transmits energy and momentum to the target matter.

29848 (LBL—16281, pp 459-462) **Entropy production by nonquasistatic phase transitions in high-energy heavy-ion reactions.** Csernai, L.P.; Lukacs, B. (Central Research Inst. for Physics, Budapest, Hungary). Dec 1983. NTIS, PC A99/MF A01. Order Number DE84005862. (CONF-830675—). TI84005862

From 6. high energy heavy ion study and 2. workshop on anomalons; Berkeley, CA, USA (28 Jun 1983).

There are different views of which are the most essential entropy-producing mechanisms: shock waves, viscosity, chemical reactions far from equilibrium, or the initial thermalization of the transparent nuclear matter as described in cascade models. However, it is important to note that quasistatic phase transitions (PTs) alone do not lead to entropy generation. Usually the produced entropy is estimated by a shock wave approximation with a given equation of state. If the shock wave approximation is applicable the generated entropy is determined completely, irrespective of the other irreversible processes within the shock front, so also when a PT is present. But in this letter case the extra entropy generation is due to the softening of the equation of state only and not directly connected with the PT. On the other hand, there are doubts about the applicability of the stationary shock wave approximation in the presence of a PT. The conventional shock wave approximation is also not applicable at ultrarelativistic energies, where the matter is expected to become transparent. In these latter cases the amount of generated entropy can only be evaluated by considering each irreversible process individually. The contribution of viscosity [4], non-equilibrium chemical reactions and initial thermalization has already been discussed. The PT may also contribute to entropy generation in itself provided that the transition is not quasistatic. Our aim is to estimate this kind of entropy production.

29849 (LBL—16281, pp 463-477) **Partons in nuclear collisions before recombination.** Hwa, R.C. (Univ. of Oregon, Eugene). Dec 1983. NTIS, PC A99/MF A01. Order Number DE84005862. (CONF-830675—). Contract AT06-76ER70004. TI84005862

From 6. high energy heavy ion study and 2. workshop on anomalons; Berkeley, CA, USA (28 Jun 1983).

Nucleus-nucleus collisions at asymptotic energies are considered in the parton basis. Using parton distributions in hadronic processes as input, we calculate, in the context of a simple thermalization model, the parton number density and energy density in the nucleus fragmentation region. 13 references.

29850 (LBL—16281, pp 479-482) **Central collisions of heavy ions in the dual parton model.** Capella, A.; Pajares, C.; Ramallo, A.V. (Universite de Paris-Sud, Orsay, France; Univ. of Santiago de Compostela, Spain). Dec 1983. NTIS, PC A99/MF A01. Order Number DE84005862. (CONF-830675—). TI84005862

From 6. high energy heavy ion study and 2. workshop on anomalons; Berkeley, CA, USA (28 Jun 1983).

Average multiplicities and rapidity densities in high energy nucleus-nucleus collisions are computed in the framework of the

dual parton model. Particular attention is given to the case of central collisions. 7 references.

29851 (LBL—16281, pp 483-486) **Thermalization of central products in ultra-relativistic heavy ion collisions.** Date, S.; Miyamura, O.; Ochiai, T.; Sumiyoshi, H.; Suzuki, N. (Waseda Univ., Tokyo, Japan; Osaka Univ., Toyonaka, Japan; Rikkyo Univ., Tokyo, Japan; Univ. of Tokyo, Tanashi, Japan). Dec 1983. NTIS, PC A99/MF A01. Order Number DE84005862. (CONF-830675—). TI84005862

From 6. high energy heavy ion study and 2. workshop on anomalons; Berkeley, CA, USA (28 Jun 1983).

Average number of collisions per particle and the energy density are calculated for the central products in ultra-relativistic heavy ion collisions based on the multi-chain model. Within rather short time after the collision, enough collisions per particle take place in the system keeping sufficient energy density for the phase transition to quark-gluon matter (QGM) when the incident energy and the mass number are appropriately high and large. 10 references.

29852 (LBL—16281, pp 489-509) **Strangeness and phase changes in hot hadronic matter.** Rafelski, J. (CERN, Geneva, Switzerland; Universitaet Frankfurt, Germany). Dec 1983. NTIS, PC A99/MF A01. Order Number DE84005862. (CONF-830675—). TI84005862

From 6. high energy heavy ion study and 2. workshop on anomalons; Berkeley, CA, USA (28 Jun 1983).

Consequences of the hypothesis that the energy available in the collision of two relativistic heavy nuclei, at least in part of the system, is equally divided among the accessible degrees of freedom are explored. This means that there exists a domain in space in which, in a suitable Lorentz frame, the energy of the longitudinal motion has been largely transformed to transverse degrees of freedom. The physical variables characterizing such a "fireball" are: energy density, baryon number density, and total volume. The basic question concerns the internal structure of the fireball. It can consist either of individual hadrons, or instead, of quarks and gluons in a new physical phase, the plasma, in which they are deconfined and can move freely over the volume of the fireball. It appears that the phase transition from the hadronic gas phase to the quark-gluon plasma is controlled mainly by the energy density of the fireball. Several estimates lead to 0.6-1 GeV/fm^3 for the critical energy density, to be compared with 0.16 GeV/fm^3 in nuclear matter. 18 references.

29853 (LBL—16281, pp 515-518) **Pion radiation by hot quark-gluon plasma.** Rafelski, J.; Danos, M. (CERN, Geneva, Switzerland; Universitaet Frankfurt, Germany; National Bureau of Standards, Washington, DC). Dec 1983. NTIS, PC A99/MF A01. Order Number DE84005862. (CONF-830675—). TI84005862

From 6. high energy heavy ion study and 2. workshop on anomalons; Berkeley, CA, USA (28 Jun 1983).

We consider here an approximately spherical region of the perturbative QCD vacuum, filled with quarks, antiquarks and gluons. For an impenetrable surface between the perturbative and true vacuum states, the inside thermal and degeneracy pressure would lead to an expansion until either pressure equilibrium or a phase transition into individual hadrons is reached. However, if the surface is penetrable, i.e., if it allows transmission of momentum and energy (but not colour) from the inside, then this can lead to a substantial internal energy and pressure loss by radiation - the pressure acting on the surface is reduced, as not all the momentum impinging on the surface has to be reflected. On first thought, the microscopic mechanism for this transmission arises in the following manner: when a fast quark or antiquark hits the boundary, a jet-like structure filled with colour field flux, i.e., a fluxtube might be formed. For sufficiently high quark momentum, this tube, instead of retracting, splits by q anti q pair creation. The leading particle associates with the antiparticle of the pair to form a meson, while the remaining pair particle may retract into the plasma. Difficulties with this model are discussed. (WHK)

29854 (LBL—16281, pp 519-522) **Do light fermions destroy the confinement/deconfinement phase transition.** DeGrand, T.A.; DeTar, C.E. (Univ. of Colorado, Boulder; Univ. of Utah, Salt Lake City). Dec 1983. NTIS, PC A99/MF A01. Order Number DE84005862. (CONF-830675—). TI84005862

From 6. high energy heavy ion study and 2. workshop on anomalons; Berkeley, CA, USA (28 Jun 1983).

Two phenomena may give rise to a phase transition in nuclear matter at high temperatures or high densities. One is associated with the restoration of SU(2) X SU(2) chiral symmetr, the order parameter for which is the scalar density [anti psi psi]; the other is the confinement/deconfinement phase transition (CDPT), the order parameter for which is the "Wilson line" L = e/sup -F/T/ where F is the free energy of an isolated test quark. It has been shown in lattice gauge theories both in numerical calculations and in the strong coupling high temperature approximation that the SU(2) Yang-Mills theory, i.e., a theory with only gluons, undergoes a CDPT at a temperature of the order of the strong interaction confinement scale A. IN SU(3) the pure gluon theory evidently has a first order CDPT. Because of the numerical complexities of introducing fermions into lattice gauge theories and particularly because of difficulties in formulating a chirally invariant lattice version of QCD, much less is known about the chiral symmetry breaking phase transition. It has been suggested that the latter phase transition is connected with the former, but numerical evidence has been based upon such a drastic approximation (the "quenched" approximation) that one cannot make definitive statements at present. Indeed, it is not even known what effect, if any, fermions have on the CDPT. It is the purpose of the study reported upon here to address this question in a model lattice gauge theory constructed to imitate the characteristics of the CDPT of SU(3), and including a chemical potential coupled to baryon number density.

29855 **Transition-state theory for fission angular distributions: A flexible-rotor model.** Prakash, M.; Ramamurthy, V.S.; Kapoor, S.S.; Alexander, J.M. (Department of Physics, State University of New York at Stony Brook, Stony Brook, New York 11794). *Physical Review Letters;* **52**: No. 12, 990-993(19 Mar 1984). Contract AC02-76ER13001.

Current studies of heavy-ion reactions make extensive use of fission-fragment angular distributions to probe the limits of statistical equilibrium. The "standard" theory was derived for a rigid-rotor, transition-state nucleus. Here a more complete theory is developed by inclusion of the dependence of transition-state shape on orientation of the symmetry axis. It is concluded that even this improved application of the liquid drop model cannot give an adequate prediction of the Z^2/A dependence of fission-fragment anisotropies.

29856 **Rank-one inverse scattering problem: Reformulation and analytic solutions.** Hartt, K. (Physics Department, University of Rhode Island, Kingston, Rhode Island 02881). *Physical Review [Section] C: Nuclear Physics;* **29**: No. 3, 695-698(Mar 1984).

Using the K-matrix formalism, we give a simplified reformulation of the S-wave rank-one inverse scattering problem. The resulting Cauchy integral equation, obtained differently by Gourdin and Martin in their first paper, is tailored to rational representations of $F(k) = k \cot(\delta_0)$. Use of such F(k) permits a simple but general solution without integration, giving analytic form factors having a pole structure like the S matrix that are reducible to rational expressions using Pade approximants. Finally, we show a bound state pole condition is necessary, and makes the form factor unique.

29857 **Multifragmentation and the partition of angular momentum: General statistical theory.** Moretto, L.G. (Istituto Nazionale di Fisica Nucleare, Laboratorio Nazionale del Sud, Catania, Italy and Nuclear Science Division, Lawrence Berkeley Laboratory, University of California, Berkeley, California 94720). *Physical Review [Section] C: Nuclear Physics;* **29**: No. 3, 843-846(Mar 1984). Contract AC03-76SF00098.

In the wake of the statistical theory for angular momentum in binary (deep inelastic) processes, a statistical theory for the distri-

bution of angular momentum between the fragments has been developed for the case of multifragmentation (three or more fragments). From the generalized partition function, the average energy and angular momentum of each fragment are derived as well as the corresponding variances. The first moments in the two quantities suggest a "rigid rotation" limit analogous to the binary case. The components of the polarization tensor are calculated for each fragment. The role of thermally generated angular momentum versus that arising from rigid rotation is discussed. Comments are offered on the applicability of the theory to various reactions.

29858 **Approximate Dirac scattering amplitudes: Eikonal expansion.** Wallace, S.J.; Friar, J.L. (Department of Physics and Astronomy, University of Maryland, College Park, Maryland 20742). *Physical Review* [*Section*] *C: Nuclear Physics;* **29**: No. 3, 956-966(Mar 1984).

Eikonal expansions are developed for the equivalent cases of the Dirac equation with scalar and vector potentials and the Schroedinger equation with central and spin-orbit potentials. Second-order corrections to the Glauber approximation are developed. Numerical calculations relevant to proton-nucleus elastic scattering illustrate that the sequence of eikonal amplitudes converge to the Dirac amplitudes in the 300—800 MeV range considered and for forward scattering angles $0° <$ or $= \theta$/sub c.m./$<$ or $\approx 40°$.

29859 **Approach to chemical equilibrium in thermal models.** Boal, D.H. (Nuclear Science Division, Lawrence Berkeley Laboratory, University of California, Berkeley, California 94720 and Physics Department, Simon Fraser University, Burnaby, British Columbia, Canada V5A 1S6). *Physical Review* [*Section*] *C: Nuclear Physics;* **29**: No. 3, 967-972(Mar 1984).

The experimentally measured (μ^-, charged particle)/(μ^-,n) and (p,n/p,p′) ratios for the emission of energetic nucleons are used to estimate the time evolution of a system of secondary nucleons produced in a direct interaction of a projectile or captured muon. The values of these ratios indicate that chemical equilibrium is not achieved among the secondary nucleons in noncomposite induced reactions, and this restricts the time scale for the emission of energetic nucleons to be about 0.7×10^{-23} sec. It is shown that the reason why thermal equilibrium can be reached so rapidly for a particular nucleon species is that the sum of the particle spectra produced in multiple direct reactions looks surprisingly thermal. The rate equations used to estimate the reaction times for muon and nucleon induced reactions are then applied to heavy ion collisions, and it is shown that chemical equilibrium can be reached more rapidly, as one would expect.

29860 **Thermal equilibrium in proton induced reactions.** Boal, D.H.; Reid, J.H. (Theoretical Science Institute, Department of Physics, Simon Fraser University, Burnaby, British Columbia, Canada V5A1S6). *Physical Review* [*Section*] *C: Nuclear Physics;* **29**: No. 3, 973-984(Mar 1984).

The thermal model, which has been applied successfully to inclusive cross sections in heavy ion reactions, is applied here to the (p,p′) and (p,π) reactions. The thermal source temperatures and velocities determined in proton induced reactions are similar to those found in heavy ion reactions, although the temperatures are cooler in proton induced reactions. Several methods can be used to estimate the number of nucleons in the thermal source, and these are found to give roughly consistent answers. Using a classical dense gas model, an estimate is made of the lifetime of the hot source. As one might expect, the lifetime is calculated to be in the 10^{-23} sec range, indicating that the hot region probably does not cleanly separate from the nucleus before it cools off. A discussion of the limiting temperature behavior observed in this analysis is also given.

29861 **Feynman-Goldstone diagrams in a time-dependent basis.** Baranger, M.; Zahed, I. (Center for Theoretical Physics, Laboratory for Nuclear Science and Department of Physics, Massachusetts Institute of Technology, Cambridge, Massachusetts 02139). *Physical Review* [*Section*] *C: Nuclear Physics;* **29**: No. 3, 1005-1009(Mar 1984). Contract AC02-76ER03069.

A generalization of many-fermion Feynman-Goldstone diagrams is derived based on a time-dependent unperturbed Hamiltonian along with a time-dependent reference state. In lowest order, the time-dependent Hartree-Fock equations follow immediately from the same arguments which lead to static Hartree-Fock when the basis is time independent. Systematic corrections to the time-dependent Hartree-Fock mean-field approximation are obtained through higher order diagrams.

29862 **High-energy nuclear collisions.** Nagamiya, S.; Gyulassy, M. (Dept. of Physics, Faculty of Science Univ. of Tokyo, Hongo, Bunkyo-ku Tokyo). *Advances in Nuclear Physics;* **13**: 201-315(1984). Contract W-7405-ENG-48.

This chapter examines current interpretations of the available data on the properties of dense, highly excited nuclear matter. Discusses high-energy heavy-ion accelerators; the high-density-temperature nuclear domain; the experimental view; theoretical tools; quantal and classical aspects; classical tools; statistical models; hydrodynamics; intranuclear cascade; nonequilibrium quantum scattering; elements of the reaction mechanism; collision geometry; evidence for multiple collisions; inclusive proton spectra; composite formation; pion production; strange-particle production; Coulomb final-state interactions; forward and backward spectra; spectator physics; the physics of dense nuclear matter; nuclei entropy; and novel states of nuclei. Demonstrates that the field of high-energy nuclear collisions is still in a state of rapid development and flux. Recognizes the vast body of experimental work that has clarified the basic reaction mechanism. Suggests that future research focus on the following areas: measurements of extremely small cross sections; y and lepton yields; neutron-rich isotopes; multibaryonic excited states; and higher and lower beam energies.

29863 **Neutron and proton matrix elements for low-lying 2^+ transitions and the probe dependence of the nuclear deformation parameter.** Bernstein, A.M. (Massachusetts Inst. of Tech., Cambridge (USA). Dept. of Physics; Massachusetts Inst. of Tech., Cambridge (USA). Lab. for Nuclear Science); Brown, V.R. (Lawrence Livermore National Lab., CA (USA)); Madsen, V.A. (Oregon State Univ., Corvallis (USA). Dept. of Physics). *Comments on Nuclear and Particle Physics;* **11**: No. 5, 203-215(May 1983).

It is shown that the ratio of multipole matrix elements Msub(n) and Msub(p) of neutrons and protons in the nucleus is not simply proportional to N/Z as in the homogeneous collective model but depends on the shell structure of the nucleus. Correspondingly, the deformation parameter for nuclear neutrons is in general different from that of protons. This difference results in a dependence of the measured deformation parameter delta for a given transition on the external field which produces it. The systematics of Msub(n)/Msub(p) for single-closed shell and the external field dependence of delta is demonstrated for the low-lying collective 2^+ transitions.

29864 **Selective population of high-j states via heavy-ion induced transfer reactions.** Bond, P.D. (Brookhaven National Lab., Upton, NY (USA)). *Comments on Nuclear and Particle Physics;* **11**: No. 5, 231-240(May 1983).

The unique aspects of certain heavy-ion induced transfer reactions to selectively populated high spin single particle states are discussed. The use of these reactions, in conjunction with gamma-ray coincidence work, to find previously unobserved high spin states with simple configuration is demonstrated.

29865 **Anomalons: statistical fluctuation or physical fact.** Friedlander, E.M. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). *Comments on Nuclear and Particle Physics;* **11**: No. 3, 127-137(Mar 1983).

This Comment considers the central statistical arguments used to prove that the observations of short mean free paths of projectile fragments from relativistic heavy ion collisions could be attributed to statistical fluctuations only with unacceptably low probabilities. Lower limits for the statistical sample sizes, necessary for further studies of this effect, are discussed within the framework of a simple 'anomalon' model.

29866 **Nuclear saturation and nuclear forces.** Day, B.D. (Argonne National Lab., IL (USA)). *Comments on Nuclear and Particle Physics;* **11**: No. 3, 115-126(Mar 1983).

Theoretically reasonable nucleon-nucleon potentials that are fitted to two-body data are used to calculate nuclear saturation properties. The results show that some physical effect besides a two-body potential is required. Including a three-body force greatly improves the calculated saturation properties.

6540 Radiation And Shielding Physics

REFER ALSO TO CITATION(S) 28982, 29102, 29172

29867 **(AD-A—137105/3) Multi-element x-ray shields for spacecraft. Final report 1981-1983.** Bendel, W.L. (Naval Research Lab., Washington, DC (USA)). 30 Dec 1983. 21p. (NRL-MR—5248). NTIS, PC A02/MF A01.

Spacecraft electronics must be shielded against the x-rays of a distant nuclear weapon. The optimum shielding material is a mixture of heavy elements. Rads(Si) are calculated for some materials and thicknesses.

29868 **(CEA-CONF—6816) Numerical analysis of characteristic methods for transport equation solution.** Lecot, C. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France)). May 1983. 3p. (In French). (CONF-8305157—2-Summ.). NTIS (US Sales Only), PC A02/MF A01. Order Number DE84750608.

From 16. colloquium of numerical analysis; Guidel, France (24 May 1983).

Published in summary form only.

29869 **(CEA-CONF—6850) Electron transmission in one dimensional multilayer material.** Millet, M.; Pierronne, F. (CEA Centre d'Etudes de Limeil, 94 - Villeneuve-Saint-Georges (France)). Jul 1983. 6p. (CONF-830714—14). NTIS (US Sales Only), PC A02/MF A01. Order Number DE84750630.

From 20. IEEE annual conference on nuclear and space radiation effects; Gatlinburg, TN, USA (18 Jul 1983).

Using simple assumptions, it is possible to study the transmission of a monoenergetic parallel electron beam in a one dimensional multilayer material, knowing experimental or Monte Carlo results obtained in homogeneous media.

29870 **(INIS-mf—8364) Projection factors of the ranges of low energy ions.** Mannsperger, H. (Heidelberg Univ. (Germany, F.R.). Naturwissenschaftlich-Mathematische Gesamtfakultaet). 1982. 39p. (In German). NTIS (US Sales Only), PC A03/MF A01. Order Number DE84780169.

The fundamental question of the ratio of the experimentally available projected ranges to the complete ranges of heavy ions in solids in dependence of the mass ratio of the target atoms and the projectile ions was studied in this thesis. The measurements were performed in the reduced energy range of $0.04 < \text{epsilon} < 1.0$. By a renormalization of the projected ranges measured in this thesis to ranges from the literature the projection factors could be obtained on the base of the universal energy-range relation presented there.

29871 (INIS-SU—198, pp 255) **Bremsstrahlung of relativistic electrons in a quantum system de-excitation.** Almaliev, A.N.; Bafkin, I.S. 1983. (In Russian). NTIS (US Sales Only), PC A99/MF A01. Order Number DE84780104. (CONF-8304144—Summs.). TI84780104

From 23. conference on nuclear spectroscopy and nuclear structure; Moscow, USSR (19 Apr 1983).

29872 **(JINR-R—3-83-180) Investigation of the thin magnetized film transmission in ultracold neutron permanent flow.** Ignatovich, V.K.; Taran, Yu.V. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Neutron Physics). 1983. 7p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE84701690.

The theory of transmission of ultracold neutron permanent flow through sets of thin magnetized films is developed in the model of surface depolarization taking into account the film nonsymmetry and the multiple reflections between the films. Two and three film sets are investigated. The transmission of a two film set is calculated when a spin flipper was placed between the films. It is shown that for determining the nonsymmetric film polarizing properties the rearrangement or turn of the films is required. The three film set with two flippers provides a possibility to determine these properties on the invariable experimental configuration, and thus to eliminate the systematical errors. This method may be used to investigate the effect of film preparation technique on the film properties in order to improve it.

29873 (LBL—16281, pp 585-588) **Stopping of 200 GeV gold nuclei in nuclear emulsions.** Waddington, C.J.; Freier, P.S.; Fixsen, D.J. (Univ. of Minnesota, Minneapolis). Dec 1983. NTIS, PC A99/MF A01. Order Number DE84005862. (CONF-830675—). TI84005862

From 6. high energy heavy ion study and 2. workshop on anomalons; Berkeley, CA, USA (28 Jun 1983).

The residential ranges of ^{197}/sub 79/Au-nuclei stopping in nuclear emulsions has been measured for nuclei with an incident energy of 991 MeV per amu. The mean ranges observed are appreciably less than those predicted from measurements made on energetic particles of lower charge. However, by considering higher order correction terms to the rate of energy loss, good agreement can be obtained between the predicted and observed ranges. 14 references.

29874 **(MPQ—73) Heavy ion beam heated cylinders: Planning for hot dense matter experiments at GSI.** Arnold, R.; Meyer-ter-Vehn, J. (Max-Planck-Institut fuer Quantenoptik, Garching (Germany, F.R.)). Apr 1983. 17p. (CONF-830354—2). NTIS (US Sales Only), PC A02/MF A01. Order Number DE84751296.

From International workshop on atomic physics for ion driven fusion; Paris, France (21 Mar 1983).

Stopping power calculations for heavy ions of 1-100 GeV energy and results of 1D and 2D simulations of stretched target cylinders heated by intense heavy ion beams are presented. Plans to perform such experiments at GSI/Darmstadt and physics areas to be investigated are discussed.

29875 **(ORNL/TM—9023) Report to the ^{238}U discrepancy task force on SIOB fits to the ORNL, CBNM, and JAERI transmission data.** Olsen, D.K. (Oak Ridge National Lab., TN (USA)). May 1984. Contract AC05-84OR21400. 39p. (ENDF—338). NTIS, PC A03/MF A01; GPO Dep. Order Number DE84012026.

The computer code SIOB has been used to obtain least-squares simultaneous-sample shape fits to the recent ^{238}U transmission data of ORNL, CBNM, and JAERI over the energy regions 1460 to 1820 eV, 2470 to 2740 eV, and 3820 to 4000 eV. The fits indicate that much of the systematic discrepancy in the published neutron widths from these data arose in the data analysis procedure. Except for the 3820- to 4000-eV JAERI data, the systematic differences in the resulting neutron widths from the present widths are larger than those contained in any existing evaluation. These fits were performed as part of the work for the NEANDC ad hoc ^{238}U Discrepancy Task Force. 20 references.

29876 **Multiple scattering from an infinite plane slab.** Soper, A.K. (Los Alamos National Lab., NM (USA)). *Nuclear Instruments and Methods in Physics Research;* **212**: No. 1-3, 337-347(1 Jul 1983).

A straightforward iterative procedure is used to calculate multiple scattering from an infinite slab over a wide range of slab thicknesses. For thin slabs, the calculations agree well with earlier work. In particular, we find that the ratio of total scattered to primary scattered neutron currents for a thin slab is represented by the function 1/(1-delta), where delta is the ratio of secondary to primary currents. For thick slabs, the results are compared with Monte Carlo simulations of polyethylene and iron. The agreement is generally good, but the method exaggerates the ability of poly-

ethylene to attenuate 10 MeV neutrons. A model of two parallel slabs is used to discuss the reflectivity of the walls of a neutron collimator.

29877 **Some results of transfer matrix calculations for thermal neutrons.** Kim, S.Y.; Aronson, R. (New York University, New York, New York 10003). *Nuclear Science and Engineering;* **73**: No. 1, 56-65(Jan 1980).

The transfer matrix method is used to solve the Milne problem for a half-space for neutrons interacting with a moderator at temperature T. Two different scattering models are considered. They are the free monatomic gas of arbitrary molecular mass with constant cross sections in the center-of-mass system, and the Nelkin kernel for water. Both models permit an additional 1/v absorption cross section. The authors have obtained accurate numerical values for the diffusion length, the extrapolated end point, the critical absorption strength, and the boundary heating for a variety of values of the parameters. Comparison is made both with other calculations and with experiments.

6550 Medical Physics

REFER ALSO TO CITATION(S) 29382

29878 **Application of track calculations to radiobiology. 2. Calculations of microdosimetric quantities.** Brenner, D.J.; Zaider, M. (Los Alamos National Lab., NM). *Radiation Research;* **98**: No. 1, 14-25(Apr 1984). Contract AC02-78EV04733;W-7405-ENG-36.

In this second paper of a series, Monte Carlo-simulated proton tracks in water vapor are analyzed to yield a range of quantities that are of radiobiological interest. These include proximity functions of energy deposition, lineal energy distributions in micrometer and nanometer site sizes, and radial energy distributions. Many of these quantities cannot be measured with current experimental techniques. Some results are compared with those from analytic calculations. Also the effect on such quantities of the uncertainties in cross-sectional data used in the original Monte Carlo calculations is assessed, as is the effect of including nonionizing energy-loss events for analysis in the calculation.

6560 Solid State Physics

REFER ALSO TO CITATION(S) 29045

29879 (INIS-mf—8921, pp 34) **Confluent corrections in exactly solved models.** Adler, J. (Technion-Israel Inst. of Tech., Haifa. Dept. of Physics). 1983. NTIS (US Sales Only), PC A05/MF A01. Order Number DE84780235. (CONF-8303128—Summ.). TI84780235

From Israel Physical Society annual meeting; Ramat-Gan, Israel (24 Mar 1983).

29880 (INIS-mf—8921, pp 65) **Experimentally observed effects of transient fluctuational electron transitions and phase and polymorphic transformations in small volumes of solids.** Khait, Yu.L. (Ben-Gurion Univ. of the Negev, Beersheba (Israel). Dept. of Physics). 1983. NTIS (US Sales Only), PC A05/MF A01. Order Number DE84780235. (CONF-8303128—Summ.). TI84780235

From Israel Physical Society annual meeting; Ramat-Gan, Israel (24 Mar 1983).

29881 (INIS-mf—8921, pp 66) **Continuous many-body melting and its experimentally observable consequences.** Khait, Yu.L. (Ben-Gurion Univ. of the Negev, Beersheba (Israel). Dept. of Physics). 1983. NTIS (US Sales Only), PC A05/MF A01. Order Number DE84780235. (CONF-8303128—Summ.). TI84780235

From Israel Physical Society annual meeting; Ramat-Gan, Israel (24 Mar 1983).

29882 **(UCRL—89743-Rev.1) Fractional quantization of the Hall effect.** Laughlin, R.B. (Lawrence Livermore National Lab., CA (USA)). 27 Feb 1984. Contract W-7405-ENG-48. 13p. (CONF-840284—1-Rev.1). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE84008894.

From 3. international winterschool on new developments in solid state physics; Salzubrg, Austria (26 Feb 1984).

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The Fractional Quantum Hall Effect is caused by the condensation of a two-dimensional electron gas in a strong magnetic field into a new type of macroscopic ground state, the elementary excitations of which are fermions of charge 1/m, where m is an odd integer. A mathematical description is presented.

29883 **First-principles calculations of materials properties.** *Energy Technology Review;* 24-33(Apr 1984).

Many Laboratory programs require accurate and detailed information about the thermodynamic properties of materials over ranges of temperature and density that are experimentally inaccessible. Dramatic advances in electron-band theory (the quantum-mechanical theory of electrons in solids and liquids) enable us to calculate reliably, for many materials, these thermodynamic properties from first principles.

29884 **Observation of chaotic behavior in an electron-hole plasma in Ge.** Held, G.A.; Jeffries, C.; Haller, E.E. (Department of Physics and Materials and Molecular Research Division, Lawrence Berkeley Laboratory, University of California, Berkeley, California 94720). *Physical Review Letters;* **52**: No. 12, 1037-1040(19 Mar 1984). Contract AC03-76SF00098.

Spontaneous current oscillations which develop chaotic behavior are reported for an electron-hole plasma in a crystal of Ge at 77 K in parallel electric and magnetic fields. The observed behavior includes a period-doubling route to chaos with increasing applied electric field, regions of broadband noise which contain noise-free periodic windows, and bifurcations from quasiperiodic states to turbulence. A rate-equation model, which includes nonlinear coupling between unstable and damped plasma density waves, is presented.

6561 Superconductivity

REFER ALSO TO CITATION(S) 28785

29885 **Coexistence of superconductivity and magnetism.** Maple, M.B. (Dept. of Physics, Univ. of California, San Diego, La Jolla, CA 92093). pp 279-346 of Advances in superconductivity. Deaver, B.; Ruvalds, J. New York, NY; Plenum Publishing Corp. (1983). Contract AT03-76ER70227.

This chapter traces the evolution of the subject of the interplay between superconductivity and magnetism, particularly the coexistence of these 2 phenomena, during the past 2 1/2 decades. The major developments and key issues are emphasized in order to provide the reader with an overview of the field since its inception in the late 1950's. Discusses the effect of rare earth ions on superconductivity in zero magnetic field; effect of rare earth ions on superconductivity in finite magnetic field (external and internal); ternary rare earth systems; exchange interaction; ferromagnetic superconductors; sinusoidally modulated magnetic state; antiferromagnetic superconductors; and superconductivity and competing magnetic interactions. Bib.

29886 **Re-entrant superconductivity.** Ruvalds, J. (Dept. of Physics, Univ. of Virginia, Charlottesville, VA 22901). pp 475-514 of Advances in superconductivity. Deaver, B.; Ruvalds, J. New York, NY; Plenum Publishing Corp. (1983). Contract AS05-81ER10959.

This chapter reviews the studies of re-entrant superconductivity starting from the original efforts to unravel the competing effects of magnetic ordering and superconducting electron pairing. Uses the Kondo effect and the theory of Mueller-Hartmann and Zittartz in order to explain the variations in T /SUB c/ with impu-

rity content for a wide variety of systems. Finds that the analysis supports the validity of applying the Kondo analysis to systems with dilute concentrations of magnetic impurities. Discusses superconductor phenomena; enhanced transition temperatures; RKKY coupling and dimensionality; and rare earth compound examples.

6570 Theoretical Physics

REFER ALSO TO CITATION(S) 29675, 29680, 29918

29887 **(BNL—34552) Finite element method for treating nearly one way wave propagation.** Goldstein, C.I. (Brookhaven National Lab., Upton, NY (USA)). 1984. Contract AC02-76CH00016. 10p. (CONF-8406113—2). NTIS, PC A02; 3; GPO Dep. Order Number DE84010294.

From 5. IMACS international symposium; Bethlehem, PA, USA (19 Jun 1984).

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A numerical method is described for approximately solving stationary wave propagation models for which the propagation is, for the most part, occurring in one principal direction. This occurs, for example, in connection with the exterior scattering problem at distances sufficiently far away from the obstacle. This also frequently occurs in wave propagation problems in a duct or waveguide (including underwater acoustic wave propagation). The numerical method is based on first factoring out the main propagation direction is the solution and then applying the finite element method. Since the solution being approximated is much smoother, it is seen that there is a great reduction in the number of grid points compared to standard finite element and finite difference methods. This is validated by means of numerical experiments. 132 references.

29888 **(IC—82/197) Gauge and non-gauge curvature tensor copies.** Srivastava, P.P. (International Centre for Theoretical Physics, Trieste (Italy)). Oct 1982. 12p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE84701660.

A procedure for constructing curvature tensor copies is discussed using the anholonomic geometrical framework. The corresponding geometries are compared and the notion of gauge copy is elucidated. An explicit calculation is also made.

29889 **(IC—82/205) Supersymmetric particles in N=2 superspace: phase space variables and Hamilton dynamics.** Azcarraga, J.A. de; Lukierski, J. (International Centre for Theoretical Physics, Trieste (Italy)). Oct 1982. 27p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE84701656.

We consider a reparametrization invariant model recently proposed based on the N-extended superPoincare group with central charges, which leads to trajectories on the N-extended Salam-Strathdee superspace. The case N=2 is discussed in detail. We show that the N=2 model is invariant under four real supergauge transformations generated by first class odd constraints which imply the Dirac equation. We introduce one bosonic (which fixes the reparametrization) and four real spinorial (which fix the supergauges) gauge conditions and calculate the Dirac brackets for the remaining unconstrained variables (x-vector,p-vector,thetasup(α),theta-barsup(α-dot)). The equations of motion are written in Hamiltonian form, with H varies as to Tr set containing Qsub(αi),Q-barsub(β-doti) and correspond to the Heisenberg equations of the (first) quantized theory.

29890 **(IC—82/206) Stability of merons in gravitational models.** Akdeniz, K.G.; Hacinliyan, A.; Kalayci, J. (International Centre for Theoretical Physics, Trieste (Italy)). Nov 1982. 17p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE84701661.

The stability properties of merons are investigated in gravitational models by taking the DeAFF model as a theoretical laboratory. We find that in gravitational models containing Yang-Mills fields merons are unstable. Stability might be possible in N=4 supergravity models with Asub(μ)=0.

29891 **(IC—82/213) Equations of motion for a radiating charged particle in electromagnetic fields on curved spacetime.** Prasanna, A.R. (International Centre for Theoretical Physics, Trieste (Italy)). Nov 1982. 9p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE84701662.

In this note we present the equations of motion for a radiating charged particle in the framework of general relativity and give a formal procedure of solving the system numerically using iterations, when the motion is confined to the equatorial plane.

29892 **(IC—83/3) Symmetry aspects of Kaluza-Klein theories.** Strathdee, J. (International Centre for Theoretical Physics, Trieste (Italy)). Jan 1983. 27p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE84701664.

General features of Kaluza-Klein theories are discussed with emphasis on the problem of determining the ground state geometry and its symmetry. A technique is described for setting up harmonic expansions in cases where the internal space is a coset space.

29893 **(IC—83/18) Finite temperature effects of quantum gravity.** Mukku, C.; Sayed, W.A. (International Centre for Theoretical Physics, Trieste (Italy)). Feb 1983. 27p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE84701663.

We obtain the temperature dependent contributions to the free energy density of a system of thermal gravitons and scalars. These terms are qualitatively different in character and, unlike the previously examined cases of scalars, vectors, and fermions, can contribute negatively to the free energy density in the high temperature limit.

29894 **(IC—83/34) SO(4) gauging of N=2 supergravity in seven dimensions.** Salam, A.; Sezgin, E. (International Centre for Theoretical Physics, Trieste (Italy)). Mar 1983. 14p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE84701665.

We obtain N=2 supergravity theory coupled to N=2 matter by truncation of the N=4 theory in seven dimensions. The truncated theory possesses global GL(4,R) x local composite SO(4) invariance. We then gauge the global SO(4) subgroup of GL(4,R), and preserve the composite SO(4) symmetry, following the method of de Wit and Nicolai in d=4. The resulting action has a potential which contains all ten scalars of the theory. The single second rank antisymmetric tensor field in the theory has a generalized field strength, which contains the Chern-Simons 3-form.

29895 **(IC—83/41) Time-energy uncertainty relation and irreversibility in quantum mechanics.** Bonifacio, R. (International Centre for Theoretical Physics, Trieste (Italy)). May 1983. 23p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE84701657.

We think that the meaning of time energy uncertainty relation is rather obscure in terms of a continuous description of time evolution, whereas it is consistent with a finite difference equation for the density operator with time steps tau $>=(h/2\pi)/2\Delta E$. This equation intrinsically gives irreversible state reduction to the diagonal form leading to "ergodic" behaviour even at the classical limit.

29896 **(IC—83/46) Comments on microscopic mechanics, generalizations of classical mechanics and Planck's oscillators.** Yussouff, M. (International Centre for Theoretical Physics, Trieste (Italy)). May 1983. 11p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE84701658.

The new microscopic mechanics removes the dichotomy of physics into classical and quantum phenomena. Its physical picture and connections with generalizations of classical mechanics are discussed. It gives a new meaning to Bohr's frequency relation and Planck's oscillators.

29897 **(IC—83/48) Finite temperature spinor pregeometry.** Denardo, G.; Spallucci, E. (International Centre for Theoretical Physics, Trieste (Italy)). May 1983. 14p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE84701671.

We obtain the Einstein and Yang-Mills actions as induced actions. Free fermion fields are considered as the only fundamental pregeometric objects. We study in detail the temperature behaviour of the induced Newton and gauge coupling constants. Both of them are seen to decrease as the temperature grows.

29898 **(IC—83/51) Coarse grained description of time evolution: Irreversible state reduction and time-energy relation.** Bonifacio, R. (International Centre for Theoretical Physics, Trieste (Italy)). May 1983. 12p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE84701659.

We show that a proper coarse-grained description of time evolution leads to a finite difference equation with step tau for the density operator. This implies state reduction to the diagonal form in the energy representation and a quasi ergodic behaviour of quantum mechanical ensemble averages. An intrinsic time-energy relation tau$\Delta E > = (h/2\pi)/2$ is proposed, and its equivalence to a time quantization is discussed.

29899 **(INIS-BR—101) Quantum theory of the laser radiation scattering by electrons in magnetic fields.** Rochlin, H. (Pontificia Univ. Catolica do Rio de Janeiro (Brazil). Dept. de Fisica). Aug 1981. 105p. (In Portuguese). NTIS (US Sales Only), PC A06/MF A01. Order Number DE84701921.

A system composed of an electron in a static magnetic field interacting with the quantized electromagnetic field, within the electric-dipole and the nonrelativistic approximations (with a cutoff in momentum space) is considered. The Heisenberg equations are solved exactly and the time evolution of the electric field is determined. This result is then used to obtain the spectrum of the scattered radiation when the initial state of the field is coherent, aplying the theory of photodetection. This theory is thoroughly discussed. Several expressions proposed in the literature for the time-dependent spectrum are compared and conditions for the equivalence of these expressions are analyzed. Moreover, inaccuracies in previous treatments of the theory of photodetection are corrected. The results allow the line shape of the scattered radiation to be analyzed for magnetic fields up to 10^{12}G. The quantization of the eletromagnetic field allows one to consider the role of the natural line width, which becomes important near ressonance. In particular, the dependence of the line width on the magnetic field is analyzed. This treatment includes the renormalization of the electron mass, which keeps the results finite when the cutoff goes to infinity.

29900 (INIS-mf—8921, pp 47) **Spatial filtering with modulated volume gratings.** Ritter, D.; Peri, D. (Technion-Israel Inst. of Tech., Haifa. Faculty of Electrical Engineering). 1983. NTIS (US Sales Only), PC A05/MF A01. Order Number DE84780235. (CONF-8303128—Summ.). TI84780235

From Israel Physical Society annual meeting; Ramat-Gan, Israel (24 Mar 1983).

29901 (INIS-mf—8921, pp 30) **Relativistic quantum theory for particles with spin 1/2.** Horwitz, L.P.; Arshansky, R. (Tel Aviv Univ. (Israel). Dept. of Physics and Astronomy). 1983. NTIS (US Sales Only), PC A05/MF A01. Order Number DE84780235. (CONF-8303128—Summ.). TI84780235

From Israel Physical Society annual meeting; Ramat-Gan, Israel (24 Mar 1983).

29902 (INIS-mf—8921, pp 36) **Universality of bridge functions and its relation to variational perturbation theory and additivity of equations of state.** Rosenfeld, Y. (Israel Atomic Energy Commission, Beersheba. Nuclear Research Center-Negev). 1983. NTIS (US Sales Only), PC A05/MF A01. Order Number DE84780235. (CONF-8303128—Summ.). TI84780235

From Israel Physical Society annual meeting; Ramat-Gan, Israel (24 Mar 1983).

29903 (INIS-mf—8921, pp 13) **Recent nonlinear optical experiments using x-rays.** Freund, I. (Bar-Ilan Univ., Ramat-Gan (Israel). Dept. of Physics). 1983. NTIS (US Sales Only), PC A05/MF A01. Order Number DE84780235. (CONF-8303128—Summ.). TI84780235

From Israel Physical Society annual meeting; Ramat-Gan, Israel (24 Mar 1983).

29904 (INIS-mf—8921, pp 49) **Iterative method for reconstruction of optical fiber refractive index profile.** Potasman, R.; Peri, D. (Technion-Israel Inst. of Tech., Haifa. Faculty of Electrical Engineering). 1983. NTIS (US Sales Only), PC A05/MF A01. Order Number DE84780235. (CONF-8303128—Summ.). TI84780235

From Israel Physical Society annual meeting; Ramat-Gan, Israel (24 Mar 1983).

29905 **(JINR-R—2-83-76) Relitivistic kinematics in "observable" variables.** Strel'tsov, V.N. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy). 1983. 9p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE84701654.

A formulation of special relativity in non-Euclidian space defined by the metric form of $d\tau^2 = dx^1 dx^2 + dx^3 dx^4$ is discussed. It is noted that in particular case of (1+1) dimensions new variables $x^1 = t-z$ and $x^2 = t+z$ are directly observable in (used for definition of concepts of simultaneity and distance) radar method of value. Transition to these significantly simplifies special Lorentz transformations, theorem of velocity "summation" etc. In a general case such a simple picture does not take place. However, within the framework of this approach the notation of the Dirac equation and of the expression for probability current density, the connection of spinors with 4-vectors and others are also simplified.

29906 **(JINR-R—2-83-377) Hamiltonian structure U(p,q) of nonlinear Schroedinger equation with nonvanishing boundary equations.** Pashaev, O.K.; Sergeenkov, S.A. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Computing Techniques and Automation). 1983. 8p. (In Russian). NTIS (US Sales Only), PC A02/MF A01. Order Number DE84701653.

Canonical structure and integrability of Nonlinear Schroedinger Equation with noncompact U(p, q) isogroup is investigated. Unitarity condition rakes as to Corrider the interaction problem for infinite number of particles or the problem under nonvanishing boundary conditions. The Poisson brackets between the scattering matrix elements are calculated explicitly and the time evolution of the spectral data is given. The existence of infinite sets of local involutive conservation laws is established as well.

29907 **(TC—48413) Hidden variables and locality in quantum theory.** Shiva, Vandana. (University of Western Ontario, London (Canada)). Dec 1978. 205p. Canadian Theses on Microfiche Service, National Library of Canada, Ottawa, Canada K1A 0N4. Order Number DE84701924.

The status of hidden variables in quantum theory has been debated since the 1920s. The author examines the no-hidden-variable theories of von Neumann, Kochen, Specker and Bell, and finds that they all share one basic assumption: averaging over the hidden variables should reproduce the quantum mechanical probabilities. Von Neumann also makes a linearity assumption, Kochen and Specker require the preservation of certain functional relations between magnitudes, and Bell proposes a locality condition. It has been assumed that the extrastatistical requirements are needed to serve as criteria of success for the introduction of hidden variables because the statistical condition is trivially satisfied, and that Bell's result is based on a locality condition that is physically motivated. The author shows that the requirement of weak locality, which is not physically motivated, is enough to give Bell's result. The proof of Bell's inequality works equally well for any pair of commuting magnitudes satisfying a condition called the degeneracy principle. None of the no-hidden-variable proofs apply to a class of hidden variable theories that are not phase-space reconstructions of quantum mechanics. The author discusses one of these theories, the Bohm-Bub theory, and finds that hidden variable theories that re all

the quantum statistics, for single and sequential measurements, must introduce a randomization process for the hidden variables after each measurement. The philosophical significance of this theory lies in the role it can play in solving the conceptual puzzles posed by quantum theory.

29908 **(UCID—20075) Computer-generated movie on the short pulse electromagnetic behavior of wire objects.** Miller, E.K.; Dease, C.G. (Lawrence Livermore National Lab., CA (USA)). May 1984. Contract W-7405-ENG-48. 23p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE84012032.

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The results shown in this movie were obtained using the Thin-Wire Time Domain (TWTD) code. This code is based on a thin-wire approximation to the electric-field integral equation. The solution employs subsectional collocation with a nine-term quadratic basis function and delta-function weights, in both space and time.

29909 **Differential scattering (CIDS) of circularly polarized light by dense particles.** Bustamante, C.; Maestre, M.F.; Keller, D.; Tinoco, I. Jr. (Department of Chemistry, University of New Mexico, Albuquerque, New Mexico 87131). *Journal of Chemical Physics;* **80**: No. 10, 4817-4823(15 May 1984).

The circular intensity of differential scattering (CIDS) for structures composed of an arbitrary collection of point polarizable groups has been obtained in analytical form using the second Born approximation, both for oriented and rotationally averaged structures. It is found that: (i) A CIDS signal is present in the forward direction parallel to the light beam. This forward CIDS does not appear in CIDS patterns calculated using the first Born approximation alone; (ii) the magnitude and shape of CIDS patterns for oriented periodic structures depend only on the properties of one unit cell of the structures and are independent of the overall size; (iii) CIDS can exist for scatterers made up of a collection of spherically symmetric point polarizable groups. In the first Born approximation anisotropic polarizable groups are required for the CIDS to be different from zero. In the second Born approximation the anisotropy necessary for CIDS is generated by the interaction between the scattering groups; (iv) the CIDS is largest when the chiral dimensions of the scatterer are of the order of the wavelength of light.

29910 **Comparisons of classical and quantum dynamics for initially localized states.** Davis, M.J.; Heller, E.J. (Chemistry Division, Argonne National Laboratory, Argonne, Illinois 60439). *Journal of Chemical Physics;* **80**: No. 10, 5036-5048(15 May 1984). Contract W-31-109-ENG-38.

We compare the dynamics of quantum wave packets with the dynamics of classical trajectory ensembles. The wave packets are Gaussian with expectation values of position and momenta which centers them in phase space. The classical trajectory ensembles are generated directly from the quantum wave packets via the Wigner transform. Quantum and classical dynamics are then compared using several quantum measures and the analogous classical ones derived from the Wigner equivalent formalism. Comparisons are made for several model potentials and it is found that there is generally excellent classical—quantum correspondence except for certain specific cases of tunneling and interference. In general, this correspondence is also very good in regions of phase space where there is classical chaos.

6580 Mathematical Physics

REFER ALSO TO CITATION(S) 29879

29911 **(DOE/ER/10711—3) Applied mathematics of transport theory. Summary progress report.** Greenberg, W.; Zweifel, P.F. (Virginia Polytechnic Inst. and State Univ., Blacksburg (USA)). Mar 1984. Contract AS05-80ER10711. 13p. NTIS, PC A02/MF A01; GPO Dep. Order Number DE84011498.

A brief summary is given of research in the areas of: abstract transport theory; reacting flow systems, homogenization of transport problems, and iterative calculations; gas dynamics; and problems in statistical mechanics, plasma stability, and mathematical transport theory. (GHT)

29912 **(IC—81/104) Spectral characterization of abstract functions.** Basit, B. (International Centre for Theoretical Physics, Trieste (Italy)). Jul 1981. 27p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE84701642.

Let G be locally compact abelian group and GAMMA its dual group. Let X be locally convex complete space and X^* its dual space. In this paper we give spectral characterization of bounded uniformly continuous functions from G to X. Also, we give applications to the characterization of solutions of functional differential equations.

29913 **(IC—82/192) Integral representation of the exponentially convex functions of infinitely many variables on Hilbert spaces.** Okb El-Bab, A.S.; El-Shazli, M.S. (International Centre for Theoretical Physics, Trieste (Italy)). Dec 1982. 21p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE84701643.

Our main purpose in this paper is to apply the general theory of eigenfunctions expansions of self-adjoint operators to find the integral representation of the exponentially convex function of infinitely many variables on Hilbert spaces. The connection with the moment problem is also discussed.

29914 **(IC—82/226) Transformation methods for constrained optimization.** Gunay, S. (International Centre for Theoretical Physics, Trieste (Italy)). Dec 1982. 19p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE84701644.

We discuss transformation methods for solving nonlinear constrained minimization problems. A particular application is described in detail. Numerical results are presented and discussed.

29915 **(IC—82/227) Inherent errors in the methods of approximations. A case of two point singular perturbation problem.** Tangmanee, S. (International Centre for Theoretical Physics, Trieste (Italy)). Dec 1982. 16p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE84701645.

In this paper we discuss two related topics. First we show that the classical numerical techniques, when applied to the two-point singular perturbation problem, produce incorrect results. Better estimates by the classical methods can be obtained only when h is very small and depending on small parameter epsilon, affecting the second derivative. Thus, because of the limitation of the computer system, the discrete system involved will become unstable. Secondly we construct a class of three-point difference schemes for this problem and show that these schemes give approximate solutions converging to the analytical solutions uniformly in epsilon of order h where h is a discretization step size.

29916 **(IC—83/55) Matrix transformations and sequence spaces.** Nanda, S. (International Centre for Theoretical Physics, Trieste (Italy)). Jun 1983. 63p. NTIS (US Sales Only), PC A04/MF A01. Order Number DE84701646.

In most cases the most general linear operator from one sequence space into another is actually given by an infinite matrix and therefore the theory of matrix transformations has always been of great interest in the study of sequence spaces. The study of general theory of matrix transformations was motivated by the special results in summability theory. This paper is a review article which gives almost all known results on matrix transformations. This also suggests a number of open problems for further study and will be very useful for research workers.

29917 **(JINR—E-2-83-281) Summation of asymptotic expansions: the gxsup(2N)-anharmonic oscillator.** Ilchev, A.S.; Mitryushkin, V.K. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1983. 10p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE84701647.

The summation technique proposed earlier has been applied to the perturbation theory expansions for the ground state energy

of the quantum mechanical anharmonic oscillators V(x)=gxsup(2N). The extremely rapid growth of the expansion coefficients in the above example is shown to be not an obstacle for the summation procedure. The utilization of the principle of minimal sensitivity proposed by P. M. Stevenson in another paper has been elaborated.

29918 **Generalized vector products, duality, and octonionic identities in D = 8 geometry.** Duendarer, R.; Guersey, F.; Tze, C. (Gibbs Laboratory and Physics Department, Yale University, New Haven, Connecticut 06511). *Journal of Mathematical Physics (New York);* **25**: No. 5, 1496-1506(May 1984). Contract AC02-76ER03075.

In an explicit, unified, and covariant formulation, we study and generalize the exceptional vector products in R^8 of Zvengrowski, Gray, and Kleinfeld. We derive the associated general quadratic, cubic, and quartic G_2 invariant algebraic identities and uncover an octonionic counterpart to the d = 4 quaternionic duality. When restricted to seven dimensions the latter is an algebraic statement of absolute parallelism on S^7. We further link up with the Ogievetski—Tzeitlin vector product and obtain explicit tensor forms of the SO(7) and G_2 structure constants. SO(8) transformations related by Triality are characterized by means of invariant tensors. Possible physical applications are discussed.

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29919 **(AD-A—136768/9) Nonlinear dynamic polarization force on a relativistic test particle in a nonequilibrium beam-plasma system. Technical report.** Brandt, H.E. (Harry Diamond Labs., Washington, DC (USA)). Sep 1983. 29p. (HDL-TR—1994). NTIS, PC A03/MF A01.

The effective charge of a test particle in a nonequilibrium beam-plasma system is the sum of the actual charge and the dynamic polarization charge surrounding it. The contribution of its polarization charge to the total force on a relativistic test particle, namely the dynamic polarization force, is calculated to fourth order in the total electromagnetic field for a slowly varying, nearly spatially independent background distribution with no external fields. This relation is needed in calculations of collective radiation processes and the conditions for the occurrence of radiative instability in relativistic beam-plasma systems.

29920 **(CONF-830260—1) Transport in compact tori.** Miley, G.H. (Illinois Univ., Urbana (USA). Fusion Studies Lab.). 23 Feb 1983. Contract AC02-76ET52040. 5p. (COO—2218-302). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE84010610.

From US/Japan symposium on compact toroids; Princeton, NJ, USA (20 Feb 1983).

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The parameter B/sub e//nr/sub p/ (here, B/sub e/ is applied magnetic field strength, nr/sub p/ is the plasma density-radius product) is proposed as a key parameter for spheromak heating studies. If B/sub e//nr/sub p/ is too large, increased magnetic fluctuations limit heating; low B/sub e//nr/sub p/ value results in excessive radiation losses. An optimum range appears to be B/sub e// nr/sub p/ $\sim$ 1 to 5 x 10^{-20} Wb.

29921 **(DOE/DP/40152—T5) VUV instrument calibrations for laser-plasma studies.** Rockett, P.D.; Bird, C.R.; Shepherd, R. (KMS Fusion, Inc., Ann Arbor, MI (USA)). May 1984. Contract AC08-82DP40152. 14p. NTIS, PC A02/MF A01; GPO Dep. Order Number DE84010507.

Techniques for spectral ar ° intensity calibrations of laser-plasma VUV instrumentation are described. A flexible laboratory x-ray station is shown to yield creditable results.

29922 **(DOE/ET/51013—115) Analytic solution of the 2-D Fokker-Planck equation for LH current drive.** Krapchev, V.B.; Hewett, D.W.; Bers, A. (Massachusetts Inst. of Tech., Cambridge (USA). Plasma Fusion Center). Mar 1984. Contract AC02-78ET51013. 8p. (CONF-840311—8; PFC/CP—84-2). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE84010314.

From 4. international symposium on heating in toroidal plasmas; Rome, Italy (21 Mar 1984).

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We solve analytically the linearized steady-state 2-D Fokker-Planck equation for the resonant electrons in the presence of strong rf fields. In this case the diffusion coefficient D = D/sub QL/nu v/sub t/^{2} >> 1, where D/sub QL/ is the quasilinear diffusion coefficient, nu is the bulk electron-ion collisional frequency and v/sub t/ = (T/sub B//m/sub e/sup 1/2/ is the bulk electron thermal velocity. The 1-D theory [1] and a previous 2-D numerical investigation showed that the rf current generated (J) is nearly equal in the two theories. The figure of merit J/P/sub d/, where P/sub d/ is the density of power dissipated, was enhanced by a factor of 2.5 in that 2-D study compared with 1-D theory.

29923 **(DOE/ET/51013—119) Realistic modelling of lower hybrid current drive with multiple codes.** Bonoli, P.; Englade, R.; Porkolab, M. (Massachusetts Inst. of Tech., Cambridge (USA). Plasma Fusion Center). 27 Mar 1984. Contract AC02-78ET51013. 18p. (PFC/CP—84-6; CONF-840311—10). NTIS, PC A02/MF A01; GPO Dep. Order Number DE84010576.

From 4. international symposium on heating in toroidal plasmas; Rome, Italy (21 Mar 1984).

A computer model for lower hybrid current drive has been developed which combines a radial transport code, a Fokker Planck solver, and a toroidal ray tracing code. The physical mechanism in the model which allows incident lower hybrid wave power at high parallel phase velocity to eventually interact with lower phase velocity electrons and thus form a significant quasilinear plateau, is the toroidal upshift that occurs in the parallel wavenumber. The resulting rf current generation and its dependency on toroidal magnetic field agree well with experiment.

29924 **(DOE/ET/51013—121) Lower hybrid experiments at the 1 MW level on Alcator C; heating and current drive.** Porkolab, M.; Lloyd, B.; Schuss, J.J.; Takase, Y.; Texter, S.; Watterson, R.; Bonoli, P.; Englade, R.; Fiore, C.; Gandy, R. (Massachusetts Inst. of Tech., Cambridge (USA). Plasma Fusion Center). Apr 1984. Contract AC02-78ET51013. 18p. (PFC/CP—84-7; CONF-840311—11). NTIS, PC A02/MF A01; GPO Dep. Order Number DE84010586.

From 4. international symposium on heating in toroidal plasmas; Rome, Italy (21 Mar 1984).

Lower hybrid current drive and heating experiments have been carried out on the Alcator C tokamak at power levels up to 1.15 MW in the density range 1.0 x $10^{13} \leqq$ anti n/sub e/(cm^{-3}) $\leqq$ 1.0 x 10^{14}. By launching waves with 67°, 90° or 112° phasing of adjacent waveguides, maximum flat-top current drive efficiencies of eta = R(m) x n($10^{14}cm^{-3}$)I(MA)/P(MW) = 0.12 at B = 10 tesla, and eta $\simeq$ 0.08 at B = 8 tesla were obtained with molybdenum limiters. With graphite, or silicon-carbide coated graphite limiters the efficiencies were 30 to 40% lower. Current ramping experiments have also been carried out at densities up to anti n $\simeq$ 6 x $10^{13}cm^{-3}$. By phasing the adjacent waveguides at 180°, heating experiments were performed in the density range 8 x $10^{13} \leqq$ anti n(cm^{-3}) $\leqq$ 2 x 10^{14} in both hydrogen and deuterium plasmas. This range of densities corresponds to the electron Landau heating mode. Using molybdenum limiters, typical heating rates of the order of eta/sub H/ = $\delta \Sigma$ n/sub j/T/sub j//P/sub rf/ $\simeq$ 10 eV/kW $10^{13}cm^{-3}$ were obtained, whereas with the SiC coated graphite limiters heating rates up to eta/sub H/ $\simeq$ 22 were achieved. Measurements of soft and hard x-rays indicate the presence of substantial electron tails in both the current drive and the electron heating regimes. A combined transport, ray-tracing and Fokker-Planck code is used to analyze and model both the heating and the current drive results.

29925 **(DOE/NBM—4011697) Energy-level scheme and transition probabilities of Si-like ions.** Huang, K.N. (Argonne National Lab., IL (USA)). 1984. Contract W-31-109-ENG-38. 144p. NTIS, PC A07/MF A01; 1; GPO Dep. Order Number DE84011697.

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Theoretical energy levels and transition probabilities are presented for 27 low-lying levels of silicon-like ions from Z = 15 to Z = 106. The multiconfiguration Dirac-Fock technique is used to calculate energy levels and wave functions. The Breit interaction and Lamb shift contributions are calculated perturbatively as corrections to the Dirac-Fock energy. The M1 and E2 transitions between the first nine levels and the E1 transitions between excited and the ground levels are presented.

29926 **(EP-LPMI-RA—1982) 1982 - Annual progress report.** (Ecole Polytechnique, 91 - Palaiseau (France). Lab. de Physique des Milieux Ionises). 1983. 42p. (In French). NTIS (US Sales Only), PC A03/MF A01. Order Number DE84750661.

This report briefly presents the activities of the laboratory of ionized medium physics during the year 1982: laser-matter interaction and compression of targets by laser; plasma turbulence; high intensity beams of ions and electrons; negative ions produced in plasma.

29927 **(EUR-CEA-FC—1195) Modeling of the L.F. turbulent spectrum during ohmic discharges, auxiliary heating and disruptions in Tokamak.** Truc, A. (Association Euratom-CEA, Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Dept. de Recherches sur la Fusion Controlee). Jul 1983. 50p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE84750605.

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The spectrum of low frequency turbulence in the TFR tokamak, as observed along a central chord by a CO_2 laser light diffusion diagnostic, appears to be representable by four monomial branches joining to three vertices. This schematic representation permits to follow more easily the evolution of the turbulence during the life of the plasma, including the ohmic regime, the transitions to auxiliary heating and the minor and major disruptions.

29928 **(EUR-CEA-FC—1197) Experimental measurements and modelling of the WEGA boundary layer plasma.** El Shaer, M.; Ichtchenko, G. (Association Euratom-CEA, Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Dept. de Recherches sur la Fusion Controlee). Feb 1983. 48p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE84750606.

The boundary layer of the WEGA Tokamak has been investigated by using specific diagnostics: movable 4 mm microwave interferometer, several types of movable and fixed probes, Katsumata probe, and multigrid electrostatic analyzer. During the RF heating at the lower hybrid frequency, some modifications in the parameters of the boundary layer are observed which are interpreted by the ponderomotive force effects. A comparison between the measured reflection coefficients of the grill waveguides and their predicted values by a coupling theory (not taking into account the real conditions facing the Grill) is presented. A diffusion model was also made to describe this particular region and to fit the experimental results.

29929 **(GA-A—17494) Electron cyclotron heating experiments on Doublet III.** Prater, R.; Ejima, S.; Lin, S.H.; Moeller, C.; Hsu, J.Y.; Matsuda, K.; Stockdale, R. (GA Technologies, Inc., San Diego, CA (USA)). Mar 1984. Contract AT03-84ER51044. 22p. (CONF-840311—6). NTIS, PC A02/MF A01; GPO Dep. Order Number DE84010936.

From 4. international symposium on heating in toroidal plasmas; Rome, Italy (21 Mar 1984).

Electron cyclotron heating experiments on the Doublet III tokamak using up to 250 kW of power at 60 GHz have been performed. The power is launched either as a pure ordinary mode from the low field side or as a pure extraordinary mode from the high field side. The ordinary mode power has shown effective heating under suitable operating conditions, with Δ(T/sub e/ + T/sub i/) = 4.8 eV/kW at a density of 2.5 x $10^{19} m^{-3}$, in agreement with ray tracing and transport calculations. The effect of ECH on energy confinement time is small, for ECH power up to double the ohmic power. A small amount of data is available from inside launch experiments, which showed heating at densities above the ordinary mode cutoff density. Experiments with long pulse (500 msec) and high delivered power (1 MW) are planned for the summer.

29930 **(GA-A—17520) Plasma diffusion in an ergotic magnetic limiter.** Yamagishi, T.; Chu, M.S.; Bhadra, D.K.; Hinton, F.L. (GA Technologies, Inc., San Diego, CA (USA)). Apr 1984. Contract AT03-84ER53158. 20p. (CONF-840520—1). NTIS, PC A02/MF A01; GPO Dep. Order Number DE84011178.

From 6. international conference on plasma surface interactions in controlled fusion devices; Nagoya, Japan (14 May 1984).

Creation of an ergodic volume of magnetic field lines by means of a single external helical magnetic field in toroidal geometry is briefly discussed. The enhanced heat conductivity in the ergodic magnetic limiter has been calculated taking into account the cubic coherent nonlinearity of perturbations including the effect of plasma current within the limit of MHD approximation. Plasma diffusion coefficients have also been evaluated based on the two fluid model. In the quasilinear theory, without the radial electric field, the radial ion flux is found to be small. In the presence of a radial electric field under the ambipolar condition, an enhanced ion diffusion is possible.

29931 (INIS-mf—8921, pp 24) **Two dimensional x-ray spectroscopy in plasma diagnostics.** Fraenkel, B.S. (Hebrew Univ., Jerusalem (Israel). Racah Inst. of Physics). 1983. NTIS (US Sales Only), PC A05/MF A01. Order Number DE84780235. (CONF-8303128—Summ.). TI84780235

From Israel Physical Society annual meeting; Ramat-Gan, Israel (24 Mar 1983).

29932 **(IPF—82-6) Ion acceleration in the plasma focus.** Deutsch, R. (Stuttgart Univ. (Germany, F.R.). Inst. fuer Plasmaforschung). Sep 1982. 45p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE84751331.

Experimental informations are used to estimate the time dependence of the current density in the plasma focus and the electromagnetic field is determined from the Maxwell equations. The acceleration of the ions in these fields is studied. A detailed analysis of the acceleration in the compression phase, in the expansion phase and during the evolution of the m=O instability is made. It is shown, that the appearance of fast selffocused quasineutral electron beams, as a result of the betatron acceleration, has a decisive importance in the ion acceleration during the m=O constriction. Models for electromagnetic ion acceleration are described for each phase. A concordance with many experimental results can be observed.

29933 **(IPF—82-8) Numerical simulation of plasma wave phenomena.** Erz, U.; Raeuchle, E.; Weixelbaum, K. (Stuttgart Univ. (Germany, F.R.). Inst. fuer Plasmaforschung). Jun 1982. 25p. (CONF-820618—17). NTIS (US Sales Only), PC A02/MF A01. Order Number DE84751324.

From International conference on plasma physics; Goeteborg, Sweden (7 Jun 1982).

An effective plasma simulation method has been developed and is applied to the investigation of linear and nonlinear electrostatic waves, bounce effects of electrons and ions, sideband instabilities, Langmuir solitons and current driven turbulence.

29934 **(IPF—82-9) Self-organisation phenomena in the plasma focus.** Deutsch, R.; Grauf, W.; Herold, H.; Schmidt, H. (Stuttgart Univ. (Germany, F.R.). Inst. fuer Plasmaforschung). Jun 1982. 15p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE84751325.

The structure of the final minimum-energy state of the focus plasma was studied, using Taylor's relaxation theory. A superposition of the reversed pinch field and the field of eddies was obtained. Similar structures could be observed experimentally.

29935 **(IPF—82-10) Influence of the deviation from the equilibrium deuteron distribution on the neutron spectra in linear pinch geometries.** Deutsch, R.; Herold, H.; Kaeppeler, H.J.; Schmidt, H. (Stuttgart Univ. (Germany, F.R.). Inst. fuer Plasmaforschung). Jul 1982. 25p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE84751310.

In order to analyse the influence of the deviation from the equilibrium distribution of the fast deuterons on the neutron spectrum, the limiting case, corresponding to a two-dimensional monoenergetic deuteron distribution, was studied. An essential difference in comparison to the equilibrium case is the appearance of a pronounced peak in the side-on spectra at Esub(n)approx.=2.5 MeV. A comparison of the theoretical and experimental data was made. If we take into account the relaxation processes, there results a good agreement between theory and experiment.

29936 **(IPF—82-14) Plasmadynamics and neutron production of the POSEIDON plasma focus.** Grauf, W. (Stuttgart Univ (Germany, F.R.). Inst. fuer Plasmaforschung). Aug 1982. 92p. (In German). NTIS (US Sales Only), PC A05/MF A01. Order Number DE84751323.

The correlation between plasma dynamics and neutron and X-ray emission has been investigated on the plasma focus POSEIDON for various operational modes (voltage 60 kV and 70 kV; energy 280 kJ and 380 kJ; filling pressure 1 to 12 mbar, deuterium) and for several electrode geometries. Five-frame schlieren pictures of the focus plasma were taken with a schlieren set-up, equipped with 5 nitrogen lasers. The schlieren pictures were time correlated to the neutron and X-ray signals from a plastic scintillator/photomultiplier detector. A good discrimination between neutron and X-radiation was achieved.

29937 **(IPF—82-15) Recent advances in Thomson scattering: high repetition rate Thomson scattering diagnostics on large plasma devices.** Roehr, H.; Steuer, K.H.; Hirsch, K.; Salzmann, H. (Stuttgart Univ. (Germany, F.R.). Inst. fuer Plasmaforschung). Sep 1982. 30p. (CONF-8208177—1). NTIS (US Sales Only), PC A03/MF A01. Order Number DE84751332.

From 4. topical conference of the American Physical Society on high temperature plasma diagnostics; Boston, MA, USA ().

In contrast to conventional ruby laser scattering devices allowing only singly pulse measurements, time evolution of Te and ne can be obtained with multipulse lasers. Within a short time interval (proportional 1 ms) rapid variations can be investigated by employing a periodically Q-switched ruby laser. Several scattering systems under construction in different laboratories to register the time evolution of Tsub(e) and nsub(e) during the whole plasma discharge will be reported. The set-up operating successfully on the Garching tokamak ASDEX will be described in detail. This scattering system uses a Nd:YAG laser (1 J/pulse, up to 100 pps, pulse duration 30 ns, burst of max. 400 pulses) and silicon avalanche diodes as detectors. Time resolved nsub(e) and Tsub(e) measurements on different types of ASDEX discharges are shown, e.g. the electron density and electron heating during neutral beam injection in a divertor discharge. As an example of relatively fast changes of nsub(e) and Tsub(e), results on pellet injection are presented. Interferometric and ECE measurements are in good agreement with the Thomson results. Stationary "long pulse discharges" in ASDEX (10 s) at low densitites ($10^{12}cm^{-3}$) were diagnosed with reduced time resolution by averaging over several laser pulses. Measurements of the time evolution of electron temperature and -density profiles were done in a first step with a scanning mirror system. These results enables optimazing out 15 spatial-point Thomson scattering system on ASDEX.

29938 **(IPF—82-16) Proposal for a new Thomson scattering technique for large fusion devices.** Salzmann, H.; Hirsch, K. (Stuttgart Univ. (Germany, F.R.). Inst. fuer Plasmaforschung). Nov 1982. 36p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE84751333.

The application of 180° scattering using ultrashort laser pulses is proposed. Spatial resolution along the laser beam is achieved by high-speed detection allowing time-of-flight measurements. This LIDAR technique uses a minimum number of window ports, reduces drastically the number of optical components in the vicinity of the discharge vessel and makes remote control unnecessary. As an example the performance of such a system is discussed on the basis of available laser and detection technology for the JET geometry.

29939 **(IPF—82-18) Spectroscopic measurements concerning the energy distribution of ions in the belt pinch device HECTOR.** Mayer, A. (Stuttgart Univ. (Germany, F.R.). Inst. fuer Plasmaforschung). Mar 1982. 53p. (In German). NTIS (US Sales Only), PC A04/MF A01. Order Number DE84751320.

Doppler profiles of the spectral lines Dsub(α) (656,1 nm) and He-II (468,6 nm) have been measured in the deuterium discharge of the belt pinch HECTOR (2% He added) by means of a Fabry-Perot polychromator to determine the behaviour of ion temperature in space and time. Different temperatures of D and He and in addition non-thermal ion velocity distributions are produced during the shock heating phase. The formation of a thermal plasma with ion temperatures in the 100 eV range within 5 μs has been observed.

29940 **(IPF—83-2) Significance of the pinch phase for the neutron production in the plasma focus.** Hayd, A.; Maurer, M.; Meinke, P.; Kaeppeler, H.J. (Stuttgart Univ. (Germany, F.R.). Inst. fuer Plasmaforschung). Mar 1983. 22p. (In German). (CONF-8303140—1). NTIS (US Sales Only), PC A02/MF A01. Order Number DE84751341.

From 47. physicists meeting and spring meeting of DPG on atomic physics, mass spectrometry, molecular physics, high-speed phisics; Regensburg, F.R. Germany (14 Mar 1983).

Solutions of the MPD-equations of two-liquid theory for the compression phase, the pinch phase and the late phase of the plasma focus with pinch currents $>$ 500 kA also yield neutron production in the pinch phase between maximum compression and the beginning of the m = 0 instability. This has been observed experimentally at the Stuttgart plasma focus POSEIDON. The appearance of quasisolitons, the filamentation of the electric current, the neutron production and the lifetime of the pinch phase are discussed in their relation to the reactor relevance of the plasma focus.

29941 **(IPF—83-3) Basic equations for a four-component theory of turbulent magneto-plasmadynamics.** Kaeppeler, H.J. (Stuttgart Univ. (Germany, F.R.). Inst. fuer Plasmaforschung). Apr 1983. 24p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE84751344.

In the case of strong electric fields and high currents in magneto-plasmas, it is necessary to use four components in order to consider the acceleration of ions and electrons and the consecutive effects in detail. As the time scales for the microscopic and macroscopic phenomena differ by several orders of magnitude, micro-effects were treated analytically, while macroscopic flows are solved by Reduce/Fortran hybrid code. Microturbulence is considered in a quasi-linear approximation, while the hybrid code permits complete non-linear approach via a macroscopic dispersion relation. The basic equations necessary for this four-component theory are compiled in this report.

29942 **(IPP—1/213) Pellet-induced charge exchange effects in ohmically heated and NB heated tokamak plasmas.** Lengyel, L. (Max-Planck-Institut fuer Plasmaphysik, Garching (Germany, F.R.)). Mar 1983. 25p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE84751311.

Pellet injection has become a frequently used method of replacing particle losses in divertor tokamaks and of depositing particles at depths not accessible to gas puffing. Pellets can also be used as markers for diagnostic purposes, or for building-up high-density target plasmas for neutral beam injection. It was decided to perform calculations for experimental plasma conditions by applying a transport code that incorporates Monte Carlo simulation of the neutral particle transport (1D PPPL transport code BALDUR). The primary objectives of these calculations were to obtain information on the effect of cx collisions on the pellet particle deposition profile and the plasma parameter distributions, and to obtain information on the magnitudes of the resulting particle and energy losses both in ohmically and NB-injection-heated plasmas.

29943 **(IPP—1/215) Some considerations concerning fusion alpha particle diagnostics.** Schumacher, U.; Springmann, E. (Max-Planck-Institut fuer Plasmaphysik, Garching (Germany, F.R.)). Apr 1983. 39p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE84751316.

The conditions necessary for neutral doping beams suitable for diagnosing the alpha particles in high-temperature or burning D-T fusion plasmas are investigated for the example of JET extended performance plasma paramaters. It turns out that step processes have to be taken into account for the beam attenuation calculations. The necessary neutral doping beam current densities have to be beyond about 200 mA/cm² for sufficient photon density rates and neutral ⁴Hesup(o) rates, respectively, and the neutral particle energy should be above about 200 keV/amu.

29944 **(IPP—1/216) Modelling of the impurity flow in the tokamak scrape-off layer.** Neuhauser, J.; Schneider, W.; Wunderlich, R.; Lackner, K. (Max-Planck-Institut fuer Plasmaphysik, Garching (Germany, F.R.)). Apr 1983. 36p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE84751314.

The impurity flow parallel to the magnetic field lines in a collisional tokamak scrape-off layer is numerically investigated. The rate equations are solved treating each ionization state as a testfluid, which interacts with the given hydrogen background plasma via collisions and the ambipolar electric field. Collisional friction usually forces the impurities to flow nearly at hydrogen speed. Thermal forces, however, can become dominant locally for small Mach number and large temperature gradient (e.g. strong divertor recycling), causing in the divertor case impurity accumulation especially near the divertor throat. In addition self-sputtering at the target plates is calculated, showing the importance of frictional impurity acceleration in addition to the charge state dependent electrostatic energy gain.

29945 **(IPP—2/264) Calculation of the energy deposition of electron cyclotron waves in a stellarator plasma.** Zhang, Z.X. (Max-Planck-Institut fuer Plasmaphysik, Garching (Germany, F.R.)). Nov 1982. 22p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE84751313.

Based on a three-dimensional ray-tracing code, the energy deposition profiles of the electron cyclotron O-mode and X-mode at the first harmonic are calculated. The finite antenna aperture is taken into account. The energy deposition profiles are given in one dimensional form, which is related to the magnetic surfaces and can be used in transport code. The effects of the antenna aperture, the oblique angle of the axis of the antenna to the meridian plane or to the equatorial plane and the plasma parameters to the energy deposition are studied.

29946 **(IPP—4/210) Ray tracing of ion cyclotron waves in tokamak plasmas.** Brambilla, M. (Max-Planck-Institut fuer Plasmaphysik, Garching (Germany, F.R.)). Mar 1983. 45p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE84751315.

With the present report we begin the presentation of a numerical code, RAYIC, which has been developed with the purpose of applying ray tracing methods to the study of ion cyclotron heating of large tokamak plasmas. This report discusses the theory and displays the equations used by the code. In addition to a presentation of the Eikonal approximation and its use for the description of waves in axisymmetric plasmas of arbitrary meridian cross-section shape, the report contains a summary of a simplified antenna model, and of a treatment of the singular layers (two-ion hybrid and/or cyclotron resonances) where most of the absorption is expected.

29947 **(IPP—4/212) Two-ion hybrid resonances and ion cyclotron absorption in tokamak plasmas.** Brambilla, M.; Ottaviani, M. (Max-Planck-Institut fuer Plasmaphysik, Garching (Germany, F.R.)). Nov 1983. 38p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE84751300.

The behaviour of IC waves near resonances in tokamak geometry is investigated in details. For this purpose, a one-dimensional model is proposed, which takes into account the orientation of the incident wavefronts with respect both to the singular layer and to the magnetic surfaces. The differential equations describing the waves are derived again from Vlasov-Maxwell equations in the finite Larmor radius approximation; they are shown to conserve the wave power flux in the absence of dissipation, and to reproduce the local dispersion relation in the WKB limit. These equations are solved exactly in some important situations, and with the Green-function technique in the general case. The amount of power coupled to Bernstein waves and absorbed by cyclotron damping is explicitly evaluated.

29948 **(IPP—6/230) Axisymmetric MHD equilibria with flow.** Kerner, W.; Jandl, O. (Max-Planck-Institut fuer Plasmaphysik, Garching (Germany, F.R.)). Aug 1983. 48p. (IPP—1/220). NTIS (US Sales Only), PC A03/MF A01. Order Number DE84751302.

Axisymmetric, ideal MHD configurations with steady flow are computed by applying the finite element method. Rectangular elements with four to eight nodes are used. By mesh rearrangement the equilibria are obtained in flux coordinates. Accurate results without flow and with purely toroidal flow are presented.

29949 **(IPP—III/82) Charge-exchange cell for the neutral lithium beam probe on pulsator, W7a and ASDEX.** McCormick, K. (Max-Planck-Institut fuer Plasmaphysik, Garching (Germany, F.R.)). Mar 1983. 20p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE84751312.

The charge-exchange cell forming a part of the lithium-diagnostic beam-line on Pulsator, Wendelstein 7a and ASDEX is described. The cell consists of a neutralization tube of 12 cm length attached to a reservoir which supplied the neutralizing medium, either lithium or sodium. To reduce cell losses, operation is on a pulsed basis by means of a valve which seals the reservoir during periods when the beam is not on. Using sodium, neutralization efficiencies for a Li^+ beam vary typically from C.97% at 20 keV to 57% at 100 keV.

29950 **(IPP—III/86) Confinement and βsub(p)-studies in neutral injection heated ASDEX plasmas.** Wagner, F.; Becker, G.; Behringer, K.; Campbell, D.; Eberhagen, A.; Engelhardt, W.; Fussmann, G.; Gehre, O.; Gernhardt, J.; Gierke, G. von. (Max-Planck-Institut fuer Plasmaphysik, Garching (Germany, F.R.)). Mar 1983. 68p. NTIS (US Sales Only), PC A04/MF A01. Order Number DE84751317.

Neutral injection experiments into limiter and divertor discharges in ASDEX are described with hydrogen and deuterium as working gas. Two operational regimes have been observed in neutral injection heated divertor discharges. One regime is characterized by deteriorated energy and particle confinement. The global energy confinement times are comparable to those of neutral injection heated limited discharges. Tthe other regime has particle and energy confinement times comparable to those of ohmic discharges with tausub(E) = 40 - 60 msec at beam powers up to 3.1 MW. This regime is further characterized by high βsub(p)-values comparable to the aspect ratio A (βsub(p) proportional 0.65 A), by good electron heating (etasub(e) proportional 2.5 x 10^{13} eV cm^{-3} kW^{-1}) and ion heating (etasub(i) proportional 4.2 x 10^{13} eV cm^{-3} kW^{-1}). In both regimes, tausub(E) increases with plasma current but there is hardly any variation with density. The differences in confinement and scaling to ohmic discharges seem to be caused by modifications of the electron loss channel. The high βsub(p)-regime develops at an injection power >=1.8 MW, anti nsub(e) >= 3 x 10^{13} cm^{-3} and q >= 2.45, and is so far only observed in divertor discharges. There are indications that this may be due to the broad profiles with high edge temperatures which can develop in divertor discharges. An indication of broad current density profiles is given by the lack of sawtooth activity in these discharges.

29951 **(IPP—III/94) Q profile as determined by ECE.** Kissel, S. (Max-Planck-Institut fuer Plasmaphysik, Garching (Germany, F.R.)). Oct 1983. 14p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE84751301.

The current density distribution, and hence the q profile, remains an important unmeasured function of plasma radius. Only the total plasma current, and, in the case of sawtoothing discharges, the

approximate axial current density are known. By using standard models of plasma resistivity, a current density profile can be determined by the measured electron temperature profile. A technique whereby the ECE data is used in this manner is described, together with the necessary assumptions required. Results are presented together with suggestions and warnings regarding their interpretation.

29952 **(Juel—1830) Drift wave transport and origin of the disruption phenomenon.** Hasselberg, G.; Rogister, A. (Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.). Inst. fuer Plasmaphysik; Association Euratom-Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.)). Feb 1983. 48p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE84751340.

Nonlinear ion Landau damping of drift waves yields a splitting of the spectrum into a long and a short wavelength branch. The latter contributes most (> 90%) of the transport and permits to explain the observed relaxation of Tokamak plasma profiles to a weakly unstable state, in the occurence with regard to the dissipative trapped electron mode. The fluxes indeed increase much more rapidly than the linear growth rates. This result and surprising coincidences between the linear theory and empirical laws concerning the high density limit lead us to propose that the slow rise of the sawtooth pulsations of the core occurs whilst the transport in the surrounding layer is insufficient to evacuate the power deposited. The sudden relaxation takes place once the released heat pulses are capable - much as in collisionless shock waves - of exciting the trapped electron mode to a sufficient level to ensure adequate transport. The model explains many experimental features associated with these sawteeth as well as with the related plasma disruptions: contraction of the current channel, high density limit (both the scaling and the order of magnitude are predicted), etc. ...

29953 **(LA—10042-MS) Plasma energy deposition from the nuclear elastic scattering of tritons on tritons.** Devaney, J.J. (Los Alamos National Lab., NM (USA)). Mar 1984. Contract W-7405-ENG-36. 7p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE84010995.

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The rate of energy loss in a triton plasma suffered by tritons from nuclear forces elastic scattering plus nuclear Coulomb interference is calculated up to 3.5-MeV triton energy.

29954 **(LA-UR—84-1249) Diagnostics of a high current capillary discharge.** Kania, D.R.; Jones, L.A. (Los Alamos National Lab., NM (USA)). 29 Mar 1984. Contract W-7405-ENG-36. 6p. (CONF-8403100—5). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE84011369.

From Conference of Z-pinches for fusion; Alexandria, VA, USA (29 Mar 1984).

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We have demonstrated that thin (10 to 25 μm diameter) capillaries can be fabricated in suitably configured insulators for use in pulse power machines. Large currents can be used to heat these capillaries which produce photons with an energies greater than 1 keV.

29955 **(PPPL—2097) Finite Larmor radius modification of the Mercier criterion.** Connor, J.W.; Tang, W.M.; Allen, L. (Princeton Univ., NJ (USA). Plasma Physics Lab.). Apr 1984. Contract AC02-76CH03073. 16p. NTIS, PC A02/MF A01; GPO Dep. Order Number DE84010934.

The finite Larmor radius modification of the Suydam criterion involves a competition between stabilizing finite Larmor radius effects and destabilizing curvature. In the case of the toroidal calculation, corresponding to the Mercier criterion, ballooning effects from regions of unfavorable curvature must be taken into account. In the case of a model equilibrium, valid near the magnetic axis, a complete solution is obtained. Results indicate that the amount of finite Larmor radius stabilization needed to overcome the effects of unfavorable average curvature increases as a function of the toroidal ballooning parameter.

29956 **(SAI—84-3032) Azimuthal electric fields and tandem ambipolarity.** Catto, P.J.; Myra, J.R.; Lee, X.S.; Francis, G.L. (Science Applications, Inc., Boulder, CO (USA). Plasma Research Inst.). Apr 1984. Contract AC03-76ET53057. 11p. (PRI—76). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE84010843.

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The importance of retaining the azimuthal variation of the electrostatic potential in transport and ambipolarity studies is demonstrated. Because the azimuthal electric field must satisfy quasi-neutrality, equilibrium ambipolar operation permitting different ambipolar roots at different radii is energetically not possible. Moreover, in the tandem mirror model considered herein, the only acceptable ambipolar root is not accessible for significantly inverted source profiles and does not permit the density profile to invert radially.

29957 **(UCRL—90096) ICRF heating in the Tandem Mirror Experiment-Upgrade (TMX-U).** Molvik, A.W.; Cummins, W.F.; Falabella, S.; Poulsen, P.; Barter, J.; Dimonte, G.; Romesser, T.; Mett, R. (Lawrence Livermore National Lab., CA (USA); TRW, Inc., Redondo Beach, CA (USA); California Univ., Berkeley (USA)). Mar 1984. Contract W-7405-ENG-48. 13p. (CONF-840311—12). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE84010555.

From 4. international symposium on heating in toroidal plasmas; Rome, Italy (21 Mar 1984).

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Central cell plasma in Tandem Mirror Experiment-Upgrade (TMX-U) are heated with 100 kW of ICRF transmitter power to ion temperatures of 1.5 keV at densities of 2 x 10^{12} cm^{-3}. We have used two Faraday-shielded antennas: the first had one 90° loop; and the second, in current use, has two 170° loops connected in an m = 1 configuration. We are also installing a slot antenna. Optimum heating for wave launching occus below the cyclotron frequency, consistent with slow wave heating. In TMX-U, we observed a power threshold, which is consistent with computed end-loss power balance. The measured loading resistance varies with density and frequency in agreement with McVey's antenna-plasma coupling code.

29958 **Parametric excitation of ion Bernstein waves by a fast wave antenna in the ion cyclotron frequency range.** Skiff, F.; Ono, M.; Wong, K.L. (Plasma Physics Laboratory, Princeton University, Princeton, New Jersey 08544). *Physics of Fluids;* **27**: No. 5, 1051-1054(May 1984). Contract AC02-76CH03073.

Parametric excitation of ion Bernstein waves is observed with an ICRF fast wave induction loop antenna in the ion cyclotron frequency range ($\omega_0 \sim 2\Omega$/sub i/-4Ω/sub i/). Important features of the decay process are investigated and discussed.

29959 **Interpretation of end-on interferometry in field-reversed configurations.** Tuszewski, M.; McKenna, K.F. (Los Alamos National Laboratory, Los Alamos, New Mexico 87545). *Physics of Fluids;* **27**: No. 5, 1058-1060(May 1984).

For field-reversed configurations formed from a 20 mTorr static gas filling in the FRX-C device, the density in the end regions is determined by side-on interferometry. This allows us to understand the radial profiles obtained from end-on holograms, and provides a more accurate estimate of the FRC particle confinement time than previously obtained.

29960 **Variational structure of the Vlasov equation in multidimensional systems.** Dominguez, R.R.; Berk, H.L. (GA Technologies Inc., San Diego, California 92138). *Physics of Fluids;* **27**: No. 5, 1142-1147(May 1984). Contract AT03-76ET51011.

A self-adjoint structure for the Maxwell integral equations, derived for distributions satisfying the Vlasov equation, is demonstrated for a class of plasma equilibria with one ignorable coordinate. It is shown that a general type of self-adjointness is manifest for a class of systems for which there is no magnetic field compo-

nent in the ignorable direction. The integral kernel also is shown to have a natural differential operator representation.

29961 **Reduced equations for nonlinear three-dimensional plasma evolution.** Chu, M.S.; Jensen, T.H. (GA Technologies Inc., San Diego, California 92138). *Physics of Fluids;* 27: No. 5, 1194-1197(May 1984). Contract AT03-76ET51011.

It is useful to cast the plasma evolution equations for a general three-dimensional configuration in terms of a set of new gauge functions based on the magnetic field. A set of reduced equations may be arrived at in this gauge by making the simple assumption that the compressional motion is decoupled from the shear motion. The equations first proposed by Strauss can be shown as the special case when the perpendicular perturbation wavelength is much shorter than the equilibrium length scale.

29962 **Numerical solution of the resistive magnetohydrodynamic boundary layer equations.** Glasser, A.H.; Jardin, S.C.; Tesauro, G. (Physics Department, Auburn University, Auburn, Alabama 36849). *Physics of Fluids;* 27: No. 5, 1225-1242(May 1984). Contract AC02-76CH03073.

Three different techniques are presented for numerical solution of the equations governing the boundary layer of resistive magnetohydrodynamic tearing and interchange instabilities in toroidal geometry. Good agreement among these methods and with analytical results provides confidence in the correctness of the results. Solutions obtained in regimes where analytical methods fail indicate a new scaling for the tearing mode as well as the existence of a new regime of stability.

29963 **Neoclassical dielectric property of a tokamak plasma.** Hinton, F.L.; Robertson, J.A. (GA Technologies Inc., San Diego, California 92138). *Physics of Fluids;* 27: No. 5, 1243-1247(May 1984). Contract AT03-76ET51011.

The response of a tokamak plasma to a time-dependent axisymmetric radial electric field is considered. The bounce-averaged motion of magnetically trapped ions is shown to consist of a radial drift, in addition to the well-known toroidal precession. This is a neoclassical polarization drift, which is larger than the standard one by a factor B²/B²/sub theta/, the square of the ratio of total to poloidal magnetic fields. The resulting low-frequency dielectric constant is larger than the standard one by approximately the same factor, when the ions are in the banana regime of neoclassical theory.

29964 **Heliac parameter study.** Monticello, D.A.; Dewar, R.L.; Furth, H.P.; Reiman, A. (Plasma Physics Laboratory, Princeton University, Princeton, New Jersey 08544). *Physics of Fluids;* 27: No. 5, 1248-1252(May 1984). Contract AC02-76CH03073.

Helical axis stellarators (heliacs) with zero net current are found to possess very good stability properties. Helically symmetric or "straight" heliacs with bean-shaped cross sections have a first region of stability that reaches to $< \beta >$ of 30% or more. Those with circular cross sections have a second region of stability to Mercier modes. In addition, the stability properties of these plasma configurations as functions of pressure profile, helical aspect ratio, and helical period length are also reported.

29965 **Electron conductivity model for dense plasmas.** Lee, Y.T.; More, R.M. (University of California, Lawrence Livermore National Laboratory, Livermore, California 94550). *Physics of Fluids;* 27: No. 5, 1273-1286(May 1984). Contract W-7405-ENG-48.

An electron conductivity model for dense plasmas is described which gives a consistent and complete set of transport coefficients including not only electrical conductivity and thermal conductivity, but also thermoelectric power, and Hall, Nernst, Ettinghausen, and Leduc—Righi coefficients. The model is useful for simulating plasma experiments with strong magnetic fields. The coefficients apply over a wide range of plasma temperature and density and are expressed in a computationally simple form. Different formulas are used for the electron relaxation time in plasma, liquid, and solid phases. Comparisons with recent calculations and available experimental measurement show the model gives results which are sufficiently accurate for many practical applications.

29966 **Dependence of the drift cyclotron loss cone instability on the radial density gradient.** Ferron, J.R.; Wong, A.Y. (Department of Physics, University of California, Los Angeles, California 90024). *Physics of Fluids;* 27: No. 5, 1287-1300(May 1984). Contract AT03-76ET53019.

Large-amplitude fluctuations (ephi/sub rms//kT/sub e/< or ≈2) observed near the ion cyclotron frequency and its harmonics in a magnetic mirror are identified as the drift-cyclotron loss-cone (DCLC) instability through measurements of the frequency, wavenumber, propagation direction, and dependence on the loss cone ion velocity distribution and the radial density gradient. The mode amplitude is reduced when the plasma density and radial density gradient length are near the linear stability boundary, dropping by two orders of magnitude when the density gradient scale length is increased from 2 to 100 ion gyroradii. The mode is localized radially to a region of one ion gyrodiameter width near the location of the steepest density gradient. The bursting appearance of mode amplitude is accompanied by changes in its perpendicular wavelength as the plasma parameters change with time during its decay. Mode amplitude modulation which occurs simultaneously throughout certain flux volumes indicates that the fluctuations arise from an absolute instability. While oscillations at the fundamental of the ion-cyclotron frequency occur most frequently with the largest amplitude, a dominant mode is observed near the third harmonic of the ion cyclotron frequency localized at a steep gradient near the axis. One possible interpretation is that the wavelengths of lower harmonic DCLC modes are too long to satisfy the azimuthal quantization condition.

29967 **Excitation of internal kink modes by trapped energetic beam ions.** Chen, L.; White, R.B.; Rosenbluth, M.N. (Plasma Physics Laboratory, Princeton University, Princeton, New Jersey 08544). *Physical Review Letters;* 52: No. 13, 1122-1125(26 Mar 1984). Contract AC02-76CH03073.

Energetic trapped particles are shown to have a destabilizing effect on the internal kink mode in tokamaks. The growth rate is near the ideal magnetohydrodynamic value, but the frequency is comparable to the trapped-particle precession frequency. A model for the instability cycle gives stability properties, associated particle losses, and neutron emissivity consistent with the "fishbone" events observed in poloidal divertor experiments.

29968 **Formation of a 100-kA tokamak discharge in the Princeton Large Torus by lower hybrid waves.** Jobes, F.; Stevens, J.; Bell, R.; Bernabei, S.; Cavallo, A.; Chu, T.K.; Cohen, S.; Denne, B.; Efthimion, P.; Hinnov, E. (Princeton Plasma Physics Laboratory, Princeton University, Princeton, New Jersey 08544). *Physical Review Letters;* 52: No. 12, 1005-1008(19 Mar 1984). Contract AC02-76CH03073.

The development of noninductive current drive is of great importance in establishing the tokamak as a long-pulse or steady-state fusion reactor. Lower hybrid waves, carrying 200 kW of power at 800 MHz, have been launched into the Princeton Large Torus tokamak to initiate and drive the discharge current to a level in excess of 100 kA.

29969 **Nature of the beam-density effect on energy loss by nonrelativistic charged-particle beams.** Rule, D.W.; Crawford, O.H. (Naval Surface Weapons Center, White Oak, Silver Spring, Maryland 20910). *Physical Review Letters;* 52: No. 11, 934-937(12 Mar 1984). Contract W-7405-ENG-26.

The authors present a new formulation of the beam-density effect on energy loss by charged particles passing through matter, which exhibits an increased loss with a beam-shape dependence. This arises from a long-range dipolelike term contained in the two-particle vicinage function for cooperative energy loss by a pair of nonrelativistic particles. A new analytic expression for the vicinage function, which exhibits the long-range term, is also presented.

29970 **Observation of Rayleigh-Taylor-like structures in a laser-accelerated foil.** Whitlock, R.R.; Emery, M.H.; Stamper, J.A.; McLean, E.A.; Obenschain, S.P.; Peckerar, A.M.C. (Naval Research Laboratory, Washington, DC 20375). *Physical Review Letters;* 52: No. 10, 819-822(5 Mar 1984).

The development of the Rayleigh-Taylor hydrodynamic instability was studied in laser-accelerated targets by introduction of mass thickness variations in foil targets. Observations made by side-on flash x radiography showed target structures and mass redistribution effects which resemble Rayleigh-Taylor bubbles and spikes, including not only advanced broadening of the spike tips on the laser-irradiated side of the foil but also projections of mass on the unirradiated side. The observations compare well with numerical simulations.

29971 **Rotational suppression of Pfirsch-Schlueter ion thermal conductivity for a plasma.** Wong, S.K.; Hinton, F.L. (GA Technologies Incorporated, San Diego, California 92138). *Physical Review Letters;* **52**: No. 10, 827-830(5 Mar 1984). Contract AT03-76ET51011.

Ion thermal conductivity for a tokamak plasma in the collisional regime with arbitrarily large toroidal rotation is calculated from Braginskii's equations. It is found to decrease to the classical value as $\nu/\sub\ i/\bar{i}^{-1}$ for high enough collisionality.

29972 **Conductivity and transport in neon deuterium discharges in the PLT tokamak.** Meservey, E.; Bitter, M.; Daughney, C. (Princeton Univ., NJ (USA). Plasma Physics Lab.). *Nuclear Fusion;* **24**: No. 1, 3-12(Jan 1984).

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Introduction of large amounts of neon into Ohmically heated deuterium discharges in the PLT tokamak results in higher central electron temperature (Tsub(e)(0)approx.=3 keV) and values of electron energy containment time that are larger than in regular discharges at the same electron density (tausub(Ee)=44 ms at n-barsub(e)=2×10^{19} m^{-3}). For steady-state discharges with high effective Z (approx.5-8) the conductance is larger than that predicted by neoclassical theory by as much as a factor of two. Transport rates of hydrogen-like and helium-like ions can be fairly well approximated by assuming a diffusion constant of between 0.4 and 1 $m^2.s^{-1}$. Within experimental uncertainties the diffusion of hydrogen-like neon is the same for co- and counter-directed high-power neutral beams.

29973 **Excitation of upper-hybrid waves by a thermal parametric instability.** Lee, M.C. (Regis Coll. Research Center, Weston, MA (USA)); Kuo, S.P. (Polytechnic Inst. of New York, Farmingdale (USA)). *Journal of Plasma Physics;* **30**: 463-478(Dec 1983).

A purely growing instability characterized by a four-wave interaction is analysed in a uniform, magnetized plasma. Up-shifted and down-shifted upper-hybrid waves and a non-oscillatory mode can be excited by a pump wave of ordinary rather than extraordinary polarization in the case of ionospheric heating. The differential Ohmic heating force dominates over the ponderomotive force as the wave-wave coupling mechanism. The beating current at zero frequency produces a significant stabilizing effect on the excitation of short-scale modes by counterbalancing the destabilizing effect of the differential Ohmic heating. The effect of ionospheric inhomogeneity is estimated, showing a tendency to raise the thresholds of the instability. When applied to ionospheric heating experiments, the present theory can explain the excitation of field-aligned plasma lines and ionospheric irregularities with a continuous spectrum ranging from metre-scale to hundreds of metre-scale. Further, the proposed mechanism may become a competitive process to the parametric decay instability and be responsible for the overshoot phenomena of the plasma line enhancement at Arecibo.

29974 **RF-assisted current startup in the fusion engineering device.** Borowski, S.K.; Kammash, T.; Peng, Y.K.M. (University of Michigan Ann Arbor, MI 48105). *Transactions of the American Nuclear Society;* **45**: 172(Oct 1983). (CONF-831047—).

From American Nuclear Society winter meeting; San Francisco, CA, USA (30 Oct 1983).

29975 **High resolution, high rate x-ray spectrometer.** Goulding, F.S.; Landis, D.A. (to Dept. of Energy). US Patent Application 6-513,557. 14 Jul 1983. 22p. Contract AC03-76SF00098.

It is an object of the invention to provide a pulse processing system for use with detected signals of a wide dynamic range which is capable of very high counting rates, with high throughput, with excellent energy resolution and a high signal-to-noise ratio. It is a further object to provide a pulse processing system wherein the fast channel resolving time is quite short and substantially independent of the energy of the detected signals. Another object is to provide a pulse processing system having a pile-up rejector circuit which will allow the maximum number of non-interfering pulses to be passed to the output. It is also an object of the invention to provide new methods for generating substantially symmetrically triangular pulses for use in both the main and fast channels of a pulse processing system.

29976 **Space-time energy concentration and the design of DT fusion micro-explosions.** Sahlin, H.; Brandenburg, J.E. (Lawrence Livermore Laboratory, Univ. of California, Livermore, CA 94550). pp 729-744 of Energy storage, compression, and switching. Nardi, V.; Bostick, W.H.; Sahlin, H. New York, NY; Plenum Publishing Corp. (1983). (CONF-751247—). Contract W-7405-ENG-48.

From Colloquium on thermal insulators at high temperature; Paris, France (3 Dec 1975).

This chapter explores many target concepts and carries out extensive implosion calculations as part of an effort to employ a plasma focus as a driver for fusion micro-explosions. Presents some of the basic principles of micro-explosion design. Considers designs appropriate to 10^{14}, 10^{13} and 10^{12} watts/cm^2. Briefly examines the possibilities of targets requiring power densities less than 10^{12} watts/cm^2 and greater than 10^{15} watts/cm^2. The purpose of this work is to understand the space-time energy consideration of the plasma focus, through theoretical and numerical studies, and to apply this knowledge to the production of electron, ion, infrared and microwave bursts in this device. Focuses on the determination of the power per unit area of the electron and ion bursts, the mechanism of electron burst deposition in high Z materials, and on the potential application of the electron burst and its energy deposition as a driver for fusion micro-explosions. The enhancement of the ion bursts and measurement of the infrared and microwave production is left for future work.

29977 **Recent development in high energy plasma production techniques by the deflagration plasma gun.** Cheng, D.Y.; Chang, C.N.; Tripathi, P.P. (Plasma Research Laboratory, Univ. of Santa Clara, Santa Clara, CA 95053). pp 807-829 of Energy storage, compression, and switching. Nardi, V.; Bostick, W.H.; Sahlin, H. New York, NY; Plenum Publishing Corp. (1983). (CONF-751247—). Contract FG03-84CE50036.

From Colloquium on thermal insulators at high temperature; Paris, France (3 Dec 1975).

This chapter reports experimental data and experience which establish the phenomenon of deflagration in plasma as unique and with quite different properties from the normal snowplow modes. Demonstrates that extremely high velocities and energies in plasma beams are possible with obvious applications in many field and, in particular, in fusion. Suggests that the potential of deflagration beams' scalability to very high energy quasi-neutral plasma beam is possible with present day technology. Discusses plasma deflagration in a T-tube; coaxial deflagration plasma guns; a typical deflagration gun and its operating procedures; electrical design considerations; kinetic theory point of view of the deflagration acceleration of particles; measurements and results; properties of the deflagration gun; applications; inertial confinement experiments; injection into magnetic confinement systems; interaction experiments; and highly energetic beams.

29978 **Energy coupling in the plasma focus.** Wainwright, T.E.; Pickles, W.L.; Price, D.F.; Sahlin, H.L. (Lawrence Livermore Laboratory, Univ. of California, Livermore, CA 94550). pp 317-323 of Energy storage, compression, and switching. Nardi, V.; Bostick, W.H.; Sahlin, H. New York, NY; Plenum Publishing Corp. (1983). (CONF-751247—). Contract W-7405-ENG-48.

From Colloquium on thermal insulators at high temperature; Paris, France (3 Dec 1975).

This chapter reports on experiments performed with a 125-kJ plasma focus to investigate mechanisms for rapid coupling of inductively-stored energy into plasmas. Explains that the coupling can take place through the formation of an electron or ion beam that deposits its energy in a target or directly by the penetration of the magnetic field into a resistive plasma. The experiments use a replaceable conical anode tip that is intended to guide the focus to within a few millimeters of the axis, where it can suddenly deliver energy either to a small target or to particles that are accelerated. X-ray and fast-ion diagnostics are used to study the effects.

29979 **Plasma focus experiments with DT-filled microballoons.** Sahlin, H.L.; Gullickson, R.L.; Hasegawa, T.H.; Luce, J.S.; McClure, J.W.; Pickles, W.L.; Price, D.F.; Wainwright, T.E. (Lawrence Livermore Laboratory, Univ. of California, Livermore, CA 94550). pp 325-328 of Energy storage, compression, and switching. Nardi, V.; Bostick, W.H.; Sahlin, H. New York, NY; Plenum Publishing Corp. (1983). (CONF-751247—). Contract W-7405-ENG-48.

From Colloquium on thermal insulators at high temperature; Paris, France (3 Dec 1975).

This chapter describes experiments with DT-filled glass microballoons positioned near the pinch region of a plasma focus which resulted in the production of neutrons which do not appear to be due to D-T reactions. Subsequent to this series of experiments it was found that occasionally neutrons were produced in the H_2-filled plasma focus even in the absence of a DT microballoon.

29980 **Two-dimensional magnetohydrodynamic calculations for a 5 MJ plasma focus.** Maxon, S. (Lawrence Livermore Laboratory, Univ. of California, Livermore, CA 94550). pp 387-406 of Energy storage, compression, and switching. Nardi, V.; Bostick, W.H.; Sahlin, H. New York, NY; Plenum Publishing Corp. (1983). (CONF-751247—). Contract W-7405-ENG-48.

From Colloquium on thermal insulators at high temperature; Paris, France (3 Dec 1975).

This article describes the calculation of the performance of a 5 MJ plasma focus using a two-dimensional magnetohydrodynamic (2-D MHD) code. Discusses two configurations, a solid and a hollow anode. Finds an instability in the current sheath of the hollow anode which has the characteristics of the short wave length sausage instability. As the current sheath reaches the axis, the numerical solution is seen to break down. When the numerical solution breaks down, the code shows a splitting of the current sheath (from the axis to the anode) and the loss of a large amount of magnetic energy. Current-sheath stagnation is observed in the hollow anode configuration.

29981 **Ion beam production in the plasma focus device.** Guillickson, R.L.; Pickles, W.L.; Price, D.F.; Sahlin, W.H.; Wainwright, T.E. (Lawrence Livermore Laboratory, Univ. of California, Livermore, CA 94550). pp 579-596 of Energy storage, compression, and switching. Nardi, V.; Bostick, W.H.; Sahlin, H. New York, NY; Plenum Publishing Corp. (1983). (CONF-751247—). Contract W-7405-ENG-48.

From Colloquium on thermal insulators at high temperature; Paris, France (3 Dec 1975).

This chapter reports on the extension of previous studies of ion acceleration in the plasma focus device by measuring the spectrum of high energy deuterons using nuclear activation techniques. The Mather geometry plasma focus device was operated at 27 kV for a stored energy of 122 kJ. Reviews the Livermore results and compares them with recent measurements of high energy ions in the plasma focus device at other laboratories. Discusses diagnostic techniques for measuring high energy ions, including nuclear activation, particle track detectors, solid state (silicon PIN) detectors, and neutron time-of-flight measurements. Finds that ion acceleration depends strongly on pressure, and was greatest at 2 Torr, a pressure lower than that for maximum neutron production.

29982 **General principles of magnetic confinement.** Hogan, J.T. (Oak Ridge National Lab. P.O. Box Y Oak Ridge, TN). pp 35-69 of Atomic and molecular physics of controlled thermonuclear fusion. Joachain, C.J.; Post, D.E. New York, NY; Plenum Publishing Corp. (1983). (CONF-820731—).

From North Atlantic Treaty Organization Advanced Study Institute conference on atomic and molecular processes in controlled thermonuclear research; Palermo, Italy (19 Jul 1982).

This chapter examines basic magnetic confinement issues such as single particle confinement, finite pressure equilibrium and stability, and transport. Describes the major approaches to magnetic confinement; tandem (ambipolar) mirrors with their associated auxiliary barriers, tokamaks and stellarators; and EBT and Reversed Field Pinch as the leading alternatives. Discusses the evolution equations for particle, energy and, where relevant, field diffusion. Offers a case study of H /SUP o/ charge exchange with multiply charged ions. Presents a tandem mirror configuration with neutral injection to sustain the end cell density, solenoid and yin-yang coils. Points out that equilibrium and stability considerations provide the bases for transport timescale analysis.

29983 **Neutral particle beam production and injection.** Post, D.; Pyle, R. (Princeton Plasma Physics Lab. Univ. of California). pp 477-518 of Atomic and molecular physics of controlled thermonuclear fusion. Joachain, C.J.; Post, D.E. New York, NY; Plenum Publishing Corp. (1983). (CONF-820731—). Contract AC03-76SF00098.

From North Atlantic Treaty Organization Advanced Study Institute conference on atomic and molecular processes in controlled thermonuclear research; Palermo, Italy (19 Jul 1982).

This chapter shows the ways that atomic physics enters into the design, diagnosis, and application of neutral beam systems. Examines the interactions of neutral beams with confined plasmas, and the production and diagnosis of the neutral beams. Focuses on atoms, molecules, and ions of the isotopes of hydrogen, but mentions some heavier elements (e.g. oxygen). Emphasizes single-particle collisions and includes selected atomic processes on surfaces. Discusses neutral beam penetration and fast ion orbits; fast ion slowing down and plasma heating; charge exchange recombination; current drive and energy beams; neutral beam systems; positive-ion systems; negative-ion systems; efficiencies; ion sources; volume atomic processes; surface atomic processes; a source model; magnetic filters; accelerators; neutralizers; cross sections; neutral fractions; the region between neutralizer and plasma; negative-ion generators; dopplershifted light; and special topics (e.g. polarized neutral beams).

29984 **Particle diagnostics for magnetic fusion experiments.** Post, D.E. (Plasma Physics Lab. Princeton Univ. Princeton, NJ). pp 539-559 of Atomic and molecular physics of controlled thermonuclear fusion. Joachain, C.J.; Post, D.E. New York, NY; Plenum Publishing Corp. (1983). (CONF-820731—). Contract AC02-76CH03073.

From North Atlantic Treaty Organization Advanced Study Institute conference on atomic and molecular processes in controlled thermonuclear research; Palermo, Italy (19 Jul 1982).

This chapter summarizes the subset of diagnostics that relies primarily on the use of particles, and attempts to show how atomic and molecular data play a role in these diagnostics. Discusses passive charge-exchange ion temperature measurements; hydrogen beams for density, ion temperature, q and ZEFF measurements; impurity diagnostics using charge-exchange recombination; plasma electric and magnetic measurements using beams heavier than hydrogen; and alpha particle diagnostics. Points out that as fusion experiments become larger and hotter, most traditional particle diagnostics become difficult because large plasmas are difficult for neutral atoms to penetrate and the gyro-orbits of charged particles need to be larger than typically obtained with present beams to be comparable with the plasma size. Concludes that not only does the current profile affect the plasma stability, but there is a growing opinion that any serious fusion reactor will have to be steady state.

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REFER ALSO TO CITATION(S) 28734, 28746, 28747, 28749, 28750, 28751, 28752, 28754, 28755, 28756, 28757, 28758, 28759, 28760, 28770, 28771, 29007, 29007, 29921

29985 **(ANL/FPP/TM—182) New one-phase dual converter for superconducting inductive energy storage and transfer applications: the one-phase inductor-converter bridge.** Ehsani, M.; Kustom, R.L. (Argonne National Lab., IL (USA)). Mar 1984. Contract W-31-109-ENG-38. 60p. NTIS, PC A04/MF A01; 1; GPO Dep. Order Number DE84012118.

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This report presents the results of theoretical and experimental development of the one-phase Inductor-Converter Bridge (ICB). The basic operating principles of the circuit are described followed by a theoretical treatment of the dynamics and control of the system. The successful results of the first experimental operation and control of the one-phase ICB are presented and explained. Finally, a discussion of some of the interesting transient and steady state behavior of the circuit, along with some of its unique features, is given.

29986 **(CEA-CONF—6923) Target fabrication and development in the Centre d'Etudes de Limeil.** Clement, X.; Coudeville, A.; Eyharts, P.; Perrine, J.P.; Rouillard, R. (CEA Centre d'Etudes de Limeil, 94 - Villeneuve-Saint-Georges (France)). Oct 1983. 33p. (CONF-8309103—11). NTIS (US Sales Only), PC A03/MF A01. Order Number DE84750612.

From 9. international vacuum congress and 5. international conference on solid surfaces; Madrid, Spain (26 Sep 1983).

The present state of research in Limeil laboratory for the production of inertial confinement fusion targets is described in this communication. A summary of typical areas, previously investigated, including new developments, is as follows: - production of hollow glass microspheres, having wide outside diameter range and aspect-ratio, using dried-alcogels, - preparation and fabrication of low density foams having plane or hemispherical shape, - deposition of a wide range of conductive materials as well as silicon and organic polymers, - development of laser and spark erosion machining which are useful tools for producing minute parts of complex targets, - characterization and analysis of plastic or coal metal coated targets, are done by using interferometry techniques and X-ray image analysis as well as X-ray absorption measurements.

29987 **(CONF-8404137—1) Tritium breeding materials.** Hollenberg, G.W.; Johnson, C.E.; Abdou, M. (Westinghouse Hanford Co., Richland, WA (USA); Argonne National Lab., IL (USA); California Univ., Los Angeles (USA)). Mar 1984. Contract W-31-109-ENG-38. 31p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE84010521.

From American Society for Metals conference on materials for fusion energy systems; Washington, DC, USA (29 Apr 1984).

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Tritium breeding materials are essential to the operation of D-T fusion facilities. Both of the present options - solid ceramic breeding materials and liquid metal materials are reviewed with emphasis not only on their attractive features but also on critical materials issues which must be resolved.

29988 **(DOE/DP/40124—22) New model of Raman spectra in laser produced plasma.** Simon, A.; Short, R.W. (Rochester Univ., NY (USA). Lab. for Laser Energetics). 3 Jul 1984. Contract AC08-80DP40124. 5p. (CONF-840616—14). NTIS, PC A02/MF A01; GPO Dep. Order Number DE84009625.

From International conference on plasma physics; Lausanne, Switzerland (27 Jun 1984).

Experimental observations of Raman scttering in laser produced plasma can be explained by ordinary incoherent Thompson scattering, with a greatly enhanced plasma line. Transient local reversed-slope velocity distributions in the underdense region can be produced by pulses of hot electrons arising from the two-plasmon or absolute stimulated Raman instabilities (SRS-A) occurring near the quarter critical surface. A simple model yields the observed spectral gaps near the incident frequency ω_0 and near $\omega_0/2$. It also explains the correlation of onset of this scattering with onset of the SRS-A, its transient localization in frequency and time, and the weak azimuthal angular variation. The existence of an upscattered frequency band is also predicted and has been verified by experiment.

29989 **(DOE/DP/40124—24) LLE review. Quarterly report, October-December 1982.** Craxton, R.S. (ed.). (Rochester Univ., NY (USA). Lab. for Laser Energetics). 1984. Contract AC08-80DP40124. 61p. NTIS, PC A04/MF A01; GPO Dep. Order Number DE84011146.

This edition of the LLE Review contains articles on target interaction experiments on OMEGA and GDL, characterization of symmetry on OMEGA, frequency-conversion technology, advances in target characterization and picosecond research, and NLUF experiments performed on OMEGA during the first quarter of fiscal year 1983 (October-December 1982). The following are some of the highlights of the work described in this issue: (1) a theoretical analysis of illumination uniformity on spherical targets has been developed; (2) an extensive series of thermal-transport experiments at 1.05 μm on OMEGA is reported; (3) spherical targets on OMEGA have been photographed in their harmonic emissions at $2\omega_0$, $3\omega_0/2$, and $5\omega_0/2$; (4) measurements of the continuum x-ray spectra produced by ir- and uv-generated laser plasmas on GDL are reported; (5) a single, monolithic, frequency-conversion cell has been designed, and will be used for the conversion of the first six beams of OMEGA to the uv; (6) an improved interferometric technique for the characterization of nonconcentricity in transparent inertial-fusion targets has been developed; (7) an improvement in an LLE-developed system for time-resolving short electrical signals has led to the generation and measurement of a step-function electrical signal with a rise time of 850 fs; and (8) shifts and widths of hydrogenic ion lines emitted by the dense plasmas generated on OMEGA have been observed in an NLUF experiment.

29990 **(DOE/DP/40124—25) LLE Review. Quarterly report, January-March 1983. Volume 14.** Craxton, R.S. (ed.). (Rochester Univ., NY (USA). Lab. for Laser Energetics). 1983. Contract AC08-80DP40124. 67p. NTIS, PC A04/MF A01; GPO Dep. Order Number DE84011142.

The following are some of the highlights of the work described in this issue: (1) Work has continued on harmonic emission from GDL and OMEGA. A systematic study of spectral features of emissions at multiples of half the laser frequency has led to an improved understanding of these emissions as potential underdense-plasma diagnostics. (2) Theoretical progress has been made on understanding the two-plasmon-decay instability. (3) Two x-ray instruments incorporating free-standing x-ray transmission gratings have been developed. (4) Three additional developments in x-ray diagnostics are reported: high energy (12 to 14 keV) ionic spectral lines have been recorded with a Von-Hamos spectrograph, mosaic crystals have been used in a geometry which permits both high sensitivity and resolution, and two-dimensional imaging of 10-μm resolution has been achieved using Laue diffraction. (5) Improvements have been made to the laser-driven x-ray-diffraction facility on GDL, and results have been obtained on time-resolved x-ray diffraction from photostimulated biological systems. (6) An experimental system has been developed to better characterize the damage process in thin-film coatings. (7) New techniques have been developed for fabricating laser-fusion targets with ablation layers containing varying amounts of high-atomic-number material. (8) A computer-based system has been developed for the collection and reduction of visible spectroscopic data, permitting a turnaround time of a few seconds rather than several hours. (9) Spectra have been recorded of several high-Z ions in an NLUF experiment, and several new atomic levels have been identified.

29991 **(DOE/DP/40124—26) LLE Review. Quarterly report, April-June 1983.** Soures, J.M. (ed.). (Rochester Univ., NY (USA). Lab. for Laser Energetics). 1984. Contract AC08-80DP40124. 51p. NTIS, PC A04/MF A01; GPO Dep. Order Number DE84011143.

This issue of LLE Review contains articles on recent progress in the laser fusion effort, on certain aspects of the LLE advanced technology development program, and on National Laser Users Facility activities. Highlights of the work summarized in this issue include: (1) target design calculations indicating increased drive uniformity and target performance with two-color laser irradiation of directly driven, laser-fusion targets; (2) hydrodynamic efficiency measurements conducted with 351-nm laser irradiation showing a close agreement with predictions made using the two-dimensional hydrodynamic code SAGE; (3) continuing theoretical and experimental work aimed at understanding the physical processes taking place in the underdense region of laser-produced plasmas; (4) the initiation of x-ray laser experiments on OMEGA; (5) the development of liquid-crystal devices as laser-blocking, notch filters; (6) the first successful demonstration of single-shot, submicron-resolution, x-ray lithography using a laser-produced plasma as the x-ray source.

29992 **(DOE/DP/40124—27) LLE Review. Quarterly report, July-September 1983. Volume 16.** Epstein, R. (ed.). (Rochester Univ., NY (USA). Lab. for Laser Energetics). 1983. Contract AC08-80DP40124. 68p. NTIS, PC A04/MF A01; GPO Dep. Order Number DE84011145.

This volume of LLE Review contains articles on the initial phase of the infrared-to-ultraviolet conversion of OMEGA, experimental and theoretical advances in the laser-fusion effort, improved target fabrication capabilities, developments in the picosecond optics area of the LLE advanced technology program, and on the National Laser Users Facility activity.

29993 **(DOE/DP/40124—28) LLE Review. Quarterly report, October-December 1983. Volume 17.** Epstein, R. (ed.). (Rochester Univ., NY (USA). Lab. for Laser Energetics). 1984. Contract AC08-80DP40124. 64p. NTIS, PC A04/MF A01; GPO Dep. Order Number DE84011147.

This volume of LLE Review features articles on the infrared-to-ultraviolet conversion of six beams of OMEGA and on the first series of experiments conducted with the reconfigured, up-converted system; developments in the LLE advanced technology program; and activity in the National Laser Users Facility.

29994 (DOE/ER—0046/15, pp 40-43) **Comparison of activation in STARFIRE and MARS first walls.** Heinisch, H.L.; Mann, F.M. Nov 1983. NTIS, PC A07/MF A01. Order Number DE84009143. TI84009143

In Damage analysis and fundamental studies. Quarterly progress report, July-September 1983.

Activation calculations were performed for elements in the MARS and STARFIRE first-wall positions. The seven elements considered (N, Al, Ni, Mo, Cu, Nb, Pb) are those which were found from earlier STARFIRE calculations to require restrictions in order to meet NRC disposal regulations. The importance of the neutron spectrum is demonstrated by a comparison of MARS and STARFIRE results. In the harder spectrum of the MARS first-wall the same elements face restrictions, but for Ni, Mo and Nb the allowable limits are two to five times larger than in STARFIRE.

29995 (DOE/ER—0046/15, pp 120-126) **Influence of irradiation and thermal creep on stress redistribution in fusion blankets.** Blanchard, J.P.; Ghoniem, N.M. (Univ. of California, Los Angeles). Nov 1983. NTIS, PC A07/MF A01. Order Number DE84009143. TI84009143

In Damage analysis and fundamental studies. Quarterly progress report, July-September 1983.

Creep processes, due to thermal and irradiation fields, have generally been assumed to relax stresses resulting from the loading of structural components. However, in order to determine failure modes and mechanisms, a global inelastic structural analysis is required. We have recently developed the STAIRE computer program for STress Analysis Including Radiation Effects. This code is based on modified beam and arch theory for the simultaneous calculation of stresses and deflections in beams of arbitary cross-section. The work is applied to the lifetime analysis of the Mirror Advanced Reactor Study (MARS) blanket modules. The objective of the present paper is to assess the global impact (3-dimensional) of both irradiation and thermal creep strains on the stresses resulting from thermal and swelling strains. The analyzed blanket consists of semi-toroidal tubes around the plasma. Thus, pipes of hollow circular cross-sections are treated as beams hanging between the inlet and outlet headers under a variety of boundary conditions.

29996 **(DOE/ER—0046/16) Damage analysis and fundamental studies. Quarterly progress report, October-December 1983.** (USDOE Office of Energy Research, Washington, DC. Office of Fusion Energy). Feb 1984. 81p. NTIS, PC A05/MF A01; 1; GPO Dep. Order Number DE84011791.

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This report is the twenty-fourth in a series of Quarterly Technical Progress Reports on Damage Analysis and Fundamental Studies (DAFS), which is one element of the Fusion Reactor Materials Program, conducted in support of the Magnetic Fusion Energy Program of the US Department of Energy (DOE). The first eight reports in this series were numbered DOE/ET-0065/1 through 8. This report is organized along topical lines in parallel to a Program Plan of the same title so that activities and accomplishments may be followed readily, relative to that Program Plant. Thus, the work of a given laboratory may appear throughout the report. A new chapter has been added on Reduced Activation Materials to accommodate work on a topic not included in the early program plan. The Contents is annotated for the convenience of the reader.

29997 **(DOE/ER/40121—T1) Acoustic emission instrumentation system for monitoring large superconducting magnets.** Jacob, K.D. (Massachusetts Inst. of Tech., Cambridge (USA)). 1984. Contract AC02-83ER40121. 83p. NTIS, PC A05/MF A01; 1; GPO Dep. Order Number DE84009878.

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An Acoustic Emission (AE) instrumentation system has been developed for monitoring large superconducting magnet systems. This new system permits AE signal recording with improved signal-to-noise ratios and makes possible the development and use of more sophisticated data analysis techniques. The system has been designed to monitor some of the six superconducting magnets being assembled at the Oak Ridge National Laboratory under the US Department of Energy Large Coil Program (LCP). Installation, calibration, and testing of the AE system on one of the LCP coils is described. In addition, results of experiments designed to enhance the understanding of the propagation of AE signals in superconducting magnets are presented. Finally, work currently being conducted towards improving the acquisition and analysis of AE data is outlined.

29998 **(EPRI-AP—3429) Inertial confinement fusion. Technical forecast handbook.** Steele, W.G.; Salem, S.L.; McCarville, T.J.; Kulkarni, R.B.; Sicherman, A. (TRW Energy Development Group, Redondo Beach, CA (USA); Woodward-Clyde Consultants, Walnut Creek, CA (USA)). Mar 1984. 178p. EPRI-RRC, Box 50490, Palo Alto, CA 94303. Order Number DE84920341.

This report details R and D-oriented technical forecast information relating to the development of technologies necessary for commercial energy applications of inertial confinement fusion (ICF). This study has developed and applied techniques for obtaining developmental information through detailed personal interviews. A fractile Bayesian interrogation procedure was used to interview experts formally and consistently to elicit their subjective probability distributions of the time required to advance ICF-critical technologies. Interviews were performed on target gain, target fabrication, liquid metal technologies, light ion diode drivers, rf and induction linac heavy ion drivers, KrF laser drivers, and reactor cavity phenomena. The Handbook presents a discussion of the major scientific/technical issues for each topic, the results of the individual interviews and the results of combining assessments of different experts. Results of this initial application showed a reasonable amount of agreement among different experts interviewed independently on the same topic. Consequently, the obtained technical forecasts could be considered to be representative of present scientific judgements on these ICF issues. This handbook documents the data gathered from the interviews, while the direct application of the data for R and D planning is reported in a separate document.

29999 (INIS-mf—8921, pp 57) **Effects of magnetic fields on the electron heat transport in laser produced plasma.** Strauss, M.; Hazak, G.; Shvarts, D. (Israel Atomic Energy Commission, Beersheba. Nuclear Research Center-Negev); Craxton, R.S. (Rochester Univ., NY (USA). Lab. for Laser Energetics). 1983. NTIS (US Sales Only), PC A05/MF A01. Order Number DE84780235. (CONF-8303128—Summ.). TI84780235

From Israel Physical Society annual meeting; Ramat-Gan, Israel (24 Mar 1983).

30000 (INIS-SU—203, pp 80-81) **Cold cathode gaseous ion source for pure vacuum systems.** Gribanov, Yu.A.; Rybalko, V.F.; Ruzhitskij, V.V.; Khazan, S.M. 1982. (In Russian). NTIS (US Sales Only), PC A06/MF A01. Order Number DE84780155. TI84780155

In Radiation damage physics and radiation technology.

The design of the Keller-type ion source that contains no organic elements contaminating the vacuum system is presented. The source can produce gaseous-ion beams with currents ranging between 120 and 200 A. In the case of molecular gases, the content of atomic ions is about 10 %. The extraction potential is 2 to 7 kV. The power consumption of the source is about 35 W, no forced cooling being required. The source is designed for solving some problems of the accelerating technique and mass-spectrometry of secondary ions.

30001 **(IPF—82-17) Proposed 60 GHz transmission line system for ECRH on W VII-AS.** Janzen, G.; Schueller, P.G.; Thumm, M. (Stuttgart Univ. (Germany, F.R.). Inst. fuer Plasmaforschung). Dec 1982. 20p. NTIS (US Sales Only), PC A02/MF A01. Order Number DE84751319.

The transmission line and launching systems for non ohmic plasma production and heating by ECR-waves with frequencies of around 60 to 70 GHz in the Garching Wendelstein stellarator W VIIa (200 kW, 100 ms) and in the future "Advanced Stellarator" W VII-AS (800 kW, cw) are described. The ECRH systems meet the requirements for neutral gas breakdown (R-wave), heating of a "cold" plasma (X-mode) and heating of a "warm" plasma (O-mode) in a combined way. The TE_{02}/TE_{01} gyrotron output mode mixture is converted into a pure TE_{01} mode which is used for long distance transmission in smooth overmoded waveguides. Waveguide tapers with nonlinear contours, circumferentially corrugated normal mode bends with nonlinear curvature, and mode selective directional couplers will be installed in the system. A TE_{01}->TE_{11} mode converter produces an almost linearly polarized rf field for improved irradiation. The ECR-waves will be launched by focusing mirrors and corrugated polarization twist reflectors. An optional hybrid HE_{11} mode system will launch an axisymmetric, narrow centred and quasi-optical beam with nearly no cross polarization.

30002 **(IPP—1/217) ASDEX-UG. ASDEX upgrade project proposal. Phase 2.** (Max-Planck-Institut fuer Plasmaphysik, Garching (Germany, F.R.)). May 1983. 158p. NTIS (US Sales Only), PC A08/MF A01. Order Number DE84751318.

The objective of ASDEX UG is to investigate the problems relating to tokamak divertor physics and the boundary layer of hot plasmas which cannot be covered otherwise by either ASDEX or other EUROPEAN tokamaks, including JET, but whose investigation is indispensable for NET and INTOR. The configuration of ASDEX UG is changed as compared with ASDEX due to the requirement that all poloidal field coils are located outside the toroidal field magnet. This leads to a highly elongated D-shaped plasma with an "open" divertor, which does not allow to close the divertor chamber by such simple means as in ASDEX. In section 2, the aims of ASDEX UG are repeated briefly and the essential features and parameters of the tokamak system are summarized. The summary includes an overview of the tokamak design, the time schedule of design and construction concluding with the estimated investment cost and manpower required. In section 3 the tokamak system components are treated. The circuits and energy supply for the different electrical components are described in section 4. Auxiliary heating requirements and methods are discussed in section 5. Section 6 presents a survey over the periphery of the tokamak system including preparation of the building and radiation shielding. Section 7 outlines the physical programme. Section 8 is devoted to diagnostics. Finally, the principal concepts for control, data acquisition and handling are outlined in section 9.

30003 **(IPP—1/218) Centrifuge pellet injector for JET.** Andelfinger, C.; Buchelt, E.; Jacobi, D.; Lackner, E.; Schilling, H.B.; Ulrich, M.; Weber, G. (Max-Planck-Institut fuer Plasmaphysik, Garching (Germany, F.R.)). Aug 1983. 82p. NTIS (US Sales Only), PC A05/MF A01. Order Number DE84751289.

An engineering design of a centrifuge pellet injector for JET is reported as part of the Phase I contract number JE 2/9016. A rather detailed design is presented for the mechanical and electronic features. Stress calculations, dynamic behaviour and life estimates are considered. The interfaces to the JET vacuum system and CODAS are discussed. Proposals for the pellet diagnostics (velocity, mass and shape) are presented.

30004 **(IPP—1/219) Pneumatic pellet injector for JET.** Andelfinger, C.; Buechl, K.; Jacobi, D.; Sandmann, W.; Schiedeck, J.; Schilling, H.B.; Weber, G. (Max-Planck-Institut fuer Plasmaphysik, Garching (Germany, F.R.)). Jul 1983. 115p. NTIS (US Sales Only), PC A06/MF A01. Order Number DE84751290.

Pellet injection is a useful tool for plasma diagnostics of tokamaks. Pellets can be applied for investigation of particle, energy and impurity transport, fueling efficiency and magnetic surfaces. Design, operation and control of a single shot pneumatic pellet gun is described in detail including all supplies, the vacuum system and the diagnostics of the pellet. The arrangement of this injector in the torus hall and the interfaces to the JET system and CODAS are considered. A guide tube system for pellet injection is discussed but it will not be recommended for JET.

30005 **(IPP—6/228) Behaviour of beryllium in a tokamak fusion reactor.** Yip Hoi-tung. (Max-Planck-Institut fuer Plasmaphysik, Garching (Germany, F.R.)). Jun 1983. 45p. NTIS (US Sales Only), PC A03/MF A01. Order Number DE84751349.

The behaviour of beryllium in a fusion plasma was studied by using the BITC (Bologna Impurity Transport Code) code for the parameters of the JET. The radial profiles of Z-effective, ionization states and fluxes are given. The radiation losses by the beryllium impurity in a fusion reactor are estimated less than 1% of the total power input. The radiation losses by berryllium in corona equilibrium are also presented.

30006 **(Juel—1820) Resonant helical magnetic limiter.** Steffen, B.; Fuchs, G.; Nicolai, A.; Wolf, G.H. (Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.). Inst. fuer Plasmaphysik; Association Euratom-Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.)). Dec 1982. 55p. NTIS (US Sales Only), PC A04/MF A01. Order Number DE84751339.

The physical goals and principles of helical magnetic limiters are described. They are used to develop design criteria for modular structures of helical conductors, which are then applied to a special case (TEXTOR). A 1-dimensional transport code is used to predict the plasma-parameters for the helical magnetic limiter case. These calculations show a substantial reduction (as compared to a normal limiter case) of the temperatures in the plasma boundary, while the plasma density there stays sufficiently large.

30007 **(Juel-Spez—229) Manufacturing and quality test of the metal bellows of the TEXTOR vacum vessel.** Butzek, D.A.; Cordewiner, H.J.; Stickelmann, C.; Mueller, H.P.; Hemminger, R. (Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.). Zentralabteilung Allgemeine Technologie; Association Euratom-Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.)). Nov 1983. 37p. (In German). NTIS (US Sales Only), PC A03/MF A01. Order Number DE84751343.

The vacuum vessel of the TEXTOR - fusion - experiment is an all-welded metal torus consisting of eight rigid sections interconnected by eight metal bellows. The diameter of the bellows is 1300

mm. In operation the temperatures of these bellows are within the range of 300°-500°C. The heating of the vacuum vessel causes displacements of the bellows of 7 mm (axial) and 1,5 mm (lateral) respectively. Design, manufacturing and especially quality tests and acceptance tests of the metal bellows are described in this report.

30008 **(KFK—3584) Conceptual design of two helium cooled fusion blankets (ceramic and liquid breeder) for INTOR.** Dalle Donne, M.; Dorner, S.; Taczanowski, S. (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Inst. fuer Neutronenphysik und Reaktortechnik). Aug 1983. 60p. (EUR—7987-e). NTIS (US Sales Only), PC A04/MF A01. Order Number DE84751297.

Neutronic and heat transfer calculations have been performed for two helium cooled blankets for the INTOR design. The neutronic calculations show that the local tritium breeding ratios, both for the ceramic blanket (Li_8SiO_8) and for the liquid blanket ($Li_{17}Pb_{83}$) solutions, are 1.34 for natural tritium and about 1.45 using 30% Li^6 enrichment. The heat transfer calculations show that it is possible to cool the divertor section of the torus (heat flux = 1.7 MW/m²) with helium with an inlet pressure of 52 bar and an inlet temperature of 40°C. The temperature of the back face of the divertor can be kept at 130°C. With helium with the same inlet conditions it is possible to cool the first wall as well (heat flux = 0.136 MW/m²) and keep the back-face of this wall at a temperature of 120°C. For the ceramic blanket we use helium with 52 bar inlet pressure and 400°C inlet temperature to ensure sufficiently high temperatures in the breeder material. The maximum temperature in the pressure tubes containing the blanket is 450°C, while the maximum breeder particle temperature is 476°C.

30009 **(LA-UR—84-1154) Convective mechanism for inhibition of heat conduction in laser produced plasmas.** Lee, P.H.Y.; Willi, O.; Trainor, R.J. (Los Alamos National Lab., NM (USA)). 27 Jun 1984. Contract W-7405-ENG-36. 7p. (CONF-840616—15). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE84011336.

From International conference on plasma physics; Lausanne, Switzerland (27 Jun 1984).

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In laser-produced plasmas, the laser energy is absorbed only below and up to the critical density. For laser fusion applications, this energy must be transported beyond the corona via electron thermal conduction towards colder, higher density regions of the target to heat up material and cause ablation, which in turn generates an inward pressure to compress the fusion fuel. If the heat conduction is inhibited, the consequences will be a weaker ablation and therefore a weaker implosion. For many years now, the inhibition of heat conduction, i.e., the reduction of heat conduction relative to classical conduction, in laser-produced plasmas at relevant irradiances has been apparent from the large body of experimental evidence. Many mechanisms, such as dc magnetic fields, ion acoustic turbulence, and Weibel instabilities, have been proposed to be the cause of inhibition of heat conduction. Even improved calculations of the classical heat flux have been carried out to solve this problem. Nevertheless, no single one of the above mentioned mechanisms can explain the large inhibition observed in the experiments.

30010 **(LA-UR—84-1354) Ceramics for fusion devices.** Clinard, F.W. Jr. (Los Alamos National Lab., NM (USA)). 1984. Contract W-7405-ENG-36. 9p. (CONF-840570—1). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE84011409.

From Materials for future energy systems conference; Washington, DC, USA (1 May 1984).

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Ceramics are required for a number of applications in fusion devices, among the most critical of which are magnetic coil insulators, windows for RF heating systems, and structural uses. Radiation effects dominate consideration of candidate materials, although good pre-irradiation properties are a requisite. Materials and components can be optimized by careful control of chemical and microstructural content, and application of brittle material design and testing techniques. Future directions for research and development should include further extension of the data base in the areas of electrical, structural, and thermal properties; establishment of a fission neutron/fusion neutron correlation including transmutation gas effects; and development of new materials tailored to meet the specific needs of fusion reactors.

30011 **(ORNL/FEDC—83/10) Equilibrium modeling of the TFCX poloidal field coil system.** Strickler, D.J.; Miller, J.B.; Rothe, K.E.; Peng, Y.K.M. (Oak Ridge National Lab., TN (USA)). Apr 1984. Contract AC05-84OR21400. 55p. NTIS, PC A04/MF A01; GPO Dep. Order Number DE84012040.

The Toroidal Fusion Core Experiment (TFCX) isproposed to be an ignition device with a low safety factor ($q \simeq 2.0$), rf or rf-assisted startup, long inductive burn pulse ($\sim$ 300 s), and an elongated plasma cross section ($\kappa = 1.6$) with moderate triangularity ($\delta = 0.3$). System trade studies have been carried out to assist in choosing an appropriate candidate for TFCX conceptual design. This report describes an important element in these system studies - the magnetohydrodynamic (MHD) equilibrium modeling of the TFCX poloidal field (PF) coil system and its impact on the choice of machine size. Reference design points for the all-super-conducting toroidal field (TF) coil (TFCX-S) and hybrid (TFCX-H) options are presented that satisfy given PF system criteria, including volt-second requirements during burn, mechanical configuration constraints, maximum field constraints at the superconducting PF coils, and plasma shape parameters. Poloidal coil current waveforms for the TFCX-S and TFCX-H reference designs consistent with the equilibrium requirements of the plasma startup, heating, and burn phases of a typical discharge scenario are calculated. Finally, a possible option for quasi-steady-state operation is discussed.

30012 **(ORNL/Sub—79/33200/16) Development program for a 200 kW, CW gyrotron. Quarterly report No. 16, April-June 1983.** DeHope, W.J.; Ferguson, P.E.; Hart, S.L.; Matranga, V.A.; Sandoval, J.J.; Schmitt, M.J.; Tancredi, J.J. (Hughes Aircraft Co., Torrance, CA (USA). Electron Dynamics Div.). 1983. Contract AC05-84OR21400. 42p. NTIS, PC A03/MF A01; GPO Dep. Order Number DE84011717.

The objective of this program is the design and development of a millimeter-wave device to produce 200 kW of continuous wave power at 60 GHz. The device, a gyrotron oscillator, will be compatible with power delivery to an electron-cyclotron heated plasma. Smooth control of rf power over a 17 dB range is required, and the device should be capable of operation into a severely time-varying load mismatch. Progress is presented in the testing, analyses and understanding of S/N 1B behavior and in preparing S/N 3 for test in the coming report period.

30013 **(PPPL—2095) Steady-state operation of spheromaks by inductive techniques.** Janos, A. (Princeton Univ., NJ (USA). Plasma Physics Lab.). Apr 1984. Contract AC02-76CH03073. 24p. NTIS, PC A02/MF A01; GPO Dep. Order Number DE84011200.

A method to maintain a steady-state spheromak configuration inductively using the S-1 Spheromak device is described. The S-1 Spheromak formation apparatus can be utilized to inject magnetic helicity continuously (C.W., not pulsed or D.C.) into the spheromak configuration after equilibrium is achieved in the linked mode of operation. Oscillation of both poloidal- and toroidal-field currents in the flux core (psi-phi Pumping), with proper phasing, injects a net time-averaged helicity into the plasma. Steady-state maintenance relies on flux conversion, which has been earlier identified. Relevant experimental data from the operation of S-1 are described. Helicity flow has been measured and the proposed injection scheme simulated. In a reasonable time practical voltages and frequencies can inject an amount of helicity comparable to that in the initial plasma. Plasma currents can be maintained or increased. This pumping technique is similar to F-Θ Pumping of a Reversed-Field-Pinch but is applied to this inverse-pinch formation.

30014 **(PPPL-Q—40) Annual report, October 1, 1981-September 30, 1982.** Phillips, C.A. (ed.). (Princeton Univ., NJ (USA). Plasma Physics Lab.). 1984. Contract AC02-76CH03073. 97p. NTIS, PC A05/MF A01; GPO Dep. Order Number DE84011480.

The construction of the Tokamak Fusion Test Reactor (TFTR) has been proceeding in a highly satisfactory manner,

giving confidence that the project schedule will be met. The vacuum vessel and toroidal-field coil systems are now in place, and the entire mechanical assembly process is about to be completed. Experimental operation of TFTR will begin with ohmic-heating studies in early CY83, and will proceed to intensive neutral-beam heating in CY84. Radio-frequency experiments on the Princeton Large Torus (PLT) have used a new 3-MW ion cyclotron heating source to demonstrate second-harmonic heating of hydrogen ions up to temperatures of 3 keV. Lower hybrid current drive has sustained plasma currents as large as 400 kA in quasi-steady state. The 7-MW neutral-beam-heating capability of the Poloidal Divertor Experiment (PDX) was utilized to investigate finite-beta stability limits. Beta values above 3% were achieved at safety factor values as low as 1.7. A physical mechanism for beta-limitation was discovered and documented: the energetic-ion-driven, fishbone mode of MHD instability. Construction of the S-1 spheromak is progressing on schedule, with preliminary experimental operation planned for early CY83.

30015 **(RL—83-083) Heavy ion inertial fusion - an overview.** Lawson, J.D. (Rutherford Appleton Lab., Chilton (UK)). Sep 1983. 18p. (CONF-8309216—1). NTIS (US Sales Only), PC A02/MF A01. Order Number DE84701677.

From Meeting on interactions between charged particle beams and matter; Grenoble, France (1 Sep 1983).

Energetic heavy ions represent an alternative to laser light and light ions as "drivers" for supplying energy for inertial confinement fusion. To induce ignition of targets containing thermonuclear fuel, an energy of several megajoules has to be focused on to a target with radius a few millimetres in a time of some tens of nanoseconds. Serious study of the use of heavy ion drivers for producing useful power in this way has been underway for seven years, though funding has been at a low level. In this paper the requirements for targets, accelerator, and reactor vessel for containing the thermonuclear explosion are surveyed, and some of the problems to be solved before the construction of a power station can realistically be contemplated are discussed.

30016 (SAI/APPAT—23-30-31-33-34, pp 1-4) **Safety comparison of d-d and d-t fueled fusion reactors.** Dabiri, A.E.; Gurol, H. (Science Applications, Inc., La Jolla, CA). Apr 1984. NTIS, PC A02/MF A01. Order Number DE84011201. (CONF-831203—139). TI84011201

From 10. symposium on fusion engineering; Philadelphia, PA, USA (5 Dec 1983).

The purpose of this paper is to compare the safety of d-d and d-t fueled fusion reactors. Issues related to public (as opposed to personnel) safety are considered only. The reactor concepts considered are: tokamaks, tandem mirror reactors (TMRs) and compact reversed field pinch reactors (CRFPRs). It is found that the consequences of activated coolant corrosion product and activated structure release are similar for d-d and d-t reactors. The major safety related difference between the two fuel cycles is the much lower tritium inventory of d-d reactors and the absence of lithium compounds.

30017 (SAI/APPAT—23-30-31-33-34, pp 5-8) **d-d Compact reversed field pinch reactor technology assessment.** Dabiri, A.E.; Glancy, J.E. (Science Applications, Inc., La Jolla, CA). Apr 1984. NTIS, PC A02/MF A01. Order Number DE84011201. (CONF-831203—139). TI84011201

From 10. symposium on fusion engineering; Philadelphia, PA, USA (5 Dec 1983).

A quantitative comparison of the technology requirements, safety performance, and cost of a d-d compact reversed-field pinch reactor (CRFPR) relative to a d-t/CRFPR has been performed. The first wall/blanket and energy-recovery cycle for the d-d reactor is simpler and more efficient than the d-t reactor. In other technology areas (such as magnets and vacuum systems) d-d requirements are not significantly different than the d-t reactor. Tritium technology for processing the plasma exhaust is required for d-d reactors, but no tritium containment around the blanket or heat transport system is needed. Safety analysis shows similar consequences for the release of activated corrosion products or activated first wall/blanket structure. Consequences of all postulated d-d accidents for tritium releases are significantly smaller than those from the d-t reactor. Cost studies have been performed for a series of d-d reactors and compared with a d-t reactor.

30018 (SAI/APPAT—23-30-31-33-34, pp 9-12) **Compact fusion reactors availability analysis.** Dabiri, A.E.; May, R.F. (Science Applications, Inc., La Jolla, CA). Apr 1984. NTIS, PC A02/MF A01. Order Number DE84011201. (CONF-831203—139). TI84011201

From 10. symposium on fusion engineering; Philadelphia, PA, USA (5 Dec 1983).

Compact fusion reactor maintenance approach was identified, and schedule maintenance downtime analysis was performed for d-t and d-d-fueled Compact Reversed-Field Pinch Reactors (CRFPR). The results were then compared against each other, as well as against the conventional tokamak reactor design (STARFIRE). The results indicate that the d-t/CRFPR design may realize a 20 percent increase in availability over the conventional design. This increase is attributed primarily to the ability of the compact reactor power core to be replaced as an integral unit as opposed to the power core sector disassembly requirements inherent in the conventional design.

30019 (SAI/APPAT—23-30-31-33-34, pp 13-16) **Safety assessment of the MARS tandem mirror reactor.** Gurol, H.; Dabiri, A.E. (Science Applications, Inc., La Jolla, CA). Apr 1984. NTIS, PC A02/MF A01. Order Number DE84011201. (CONF-831203—139). TI84011201

From 10. symposium on fusion engineering; Philadelphia, PA, USA (5 Dec 1983).

In this study, the safety of the MARS tandem mirror reactor is assessed. Only prompt public consequences are considered. Plant boundary doses are calculated at 1000 m. The major radioactive inventories are due to the first-wall/blanket structure, coolant, and tritium. The conclusions are summarized below: (1) Mechanisms and conditions for releasing large fractions of the radioactive HT-9 structure were not found. The maximum dose is below 0.1 rem, since only oxides of molybdenum are expected to be released. (2) Because the activated corrosion products are filtered, most of the coolant activity is due to the LiPb. A LOCA can result in large doses only if this activity can be transported outside the reactor containment building. Most of the LiPb is expected to solidify. Aerosols that are produced will likely plate out on surfaces or settle. (3) Various tritium accident scenarios were considered. Release of all the tritium in the reactor building (53 g) leads to a dose of 21 rem.

30020 (SAI/APPAT—23-30-31-33-34, pp 17-20) **d-d Tandem mirror reactor assessment.** Dobrott, D.; Gurol, H.; Shuy, G.W. (Science Applications, Inc., La Jolla, CA). Apr 1984. NTIS, PC A02/MF A01. Order Number DE84011201. (CONF-831203—139). TI84011201

From 10. symposium on fusion engineering; Philadelphia, PA, USA (5 Dec 1983).

A conceptual tandem mirror reactor (TMR) that is fueled by the catalyzed-deuterium fuel cycle (Cat-d) is assessed with respect to physics, technology, safety, and cost. A comparison with respect to these issues is made between this reactor and a deuterium-tritium fueled TMR similar to that developed for the MARS study. Both designs have ends stoppered by a combination of magnetic and electrostatic fields and fusion takes place within the solenoid. The magnetic field end plugs are formed by a combination of 24 Tesla coils and a system of 8 Tesla yin-yang coils to provide stability. The ambipolar potential electron and ion plugs are formed in the yin-yangs and are created by a combination of neutral beams and electron cyclotron resonance heating (ECRH).

30021 **(SAI/APPAT—23-30-31-33-34) Papers for the 10th symposium on fusion engineering.** (Science Applications, Inc., La Jolla, CA (USA). Applied Plasma Physics and Technology Div.). Jan 1984. Contract AC03-81ER53113. 22p. (CONF-831203—139). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE84011201.

From 10. symposium on fusion engineering; Philadelphia, PA, USA (5 Dec 1983).

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Separate abstracts were prepared for the five included papers. (MOW)

30022 **(SAND—83-1519) Current status of calculations and measurements of ion stopping power in ICF plasmas.** Mehlhorn, T.A.; Peek, J.M.; McGuire, E.J.; Olsen, J.N.; Young, F.C. (Sandia National Labs., Albuquerque, NM (USA); Naval Research Lab., Washington, DC (USA)). Dec 1983. Contract AC04-76DP00789. 26p. (CONF-830354—1; SAND—83-0663C). NTIS, PC A03/MF A01; GPO Dep. Order Number DE84005880.

From International workshop on atomic physics for ion driven fusion; Paris, France (21 Mar 1983).

More precise stopping power models for use in ICF target design need to be developed. The light ion beam ICF program is now moving into a phase where ad hoc scaling of certain key physics parameters in the stopping power models is no longer sufficient. Our goal is to predict ion ranges in ICF targets to within about 10 to 20%. A verified stopping power model is also essential in diagnosing target irradiation intensities; such data can only be inferred by target response. Presently, our area of primary concern involves calculating the stopping power of the bound electrons of partially ionized atoms. One bound electron stopping power model that we are investigating uses the local oscillator model along with Hartree-Fock-Slater atomic charge density profiles to calculate I(Z,q,E), a generalized average ionization potential for the target electrons. This method is being studied systematically to look for deficiencies in the underlying physics model, especially at low projectile velocities. Another procedure uses the Generalized Oscillator Strength model to calculate the bound electron stopping. Experimental measurements of enhanced stopping power in ICF plasmas at the 0.3-TW/cm^2 level have been reported by the Naval Research Laboratory. Further experiments at Sandia are aimed at extending this data base both to higher ionization states and to higher-Z targets using a 1.2-TW/cm^2 proton beam on the PROTO-I accelerator.

30023 **(SAND—84-0117) APC-II: an electron beam propagation code.** Iwan, D.C.; Freeman, J.R. (Sandia National Labs., Albuquerque, NM (USA)). May 1984. Contract AC04-76DP00789. 35p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE84011532.

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The computer code APC-II simulates the propagation of a relativistic electron beam through air. APC-II is an updated version of the APC envelope model code. It incorporates an improved conductivity model which significantly extends the range of stable calculations. A number of test cases show that these new models are capable of reproducing the simulations of the original APC code. As the result of a major restructuring and reprogramming of the code, APC-II is now friendly to both the occasional user and the experienced user who wishes to make modifications. Most of the code is in standard ANS-II Fortran 77 so that it can be easily transported between machines.

30024 **(UCID—19837-83) RTNS-II: irradiations at the Rotating Target Neutron Source-II. 1983 annual report.** (Lawrence Livermore National Lab., CA (USA)). 1983. Contract W-7405-ENG-48. 79p. NTIS, PC A05/MF A01; 1; GPO Dep. Order Number DE84012031.

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This is the second annual report summarizing irradiation experiments and operations at RTNS-II. It covers calendar year 1983 and includes reports on all irradiations, non-fusion as well as fusion, and on utilization of Monbusho's transmission electron microscope (TEM) a RTNS-II. Each summary article has been submitted by the investigator and has been altered only to meet the style and format requirements of this report.

30025 **(UCLA/PPG—765-Vol.1) Magnetic fusion energy plasma interactive and high heat flux components. Volume I. Technical assessment of the critical issues and problem areas in the plasma materials interaction field.** Conn, R.W.; Gauster, W.B.; Heifetz, D.; Marmar, E.; Wilson, K.L. (eds.). (California Univ., Los Angeles (USA)). Jan 1984. 172p. NTIS, PC A08/MF A01; 1; GPO Dep. Order Number DE84011527.

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A technical assessment of the critical issues and problem areas in the field of plasma materials interactions (PMI) in magnetic fusion devices shows these problems to be central for near-term experiments, for intermediate-range reactor devices including D-T burning physics experiments, and for long-term reactor machines. Critical technical issues are ones central to understanding and successful operation of existing and near-term experiments/reactors or devices of great importance for the long run, i.e., ones which will require an extensive, long-term development effort and thus should receive attention now. Four subgroups were formed to assess the critical PMI issues along four major lines: (1) PMI and plasma confinement physics experiments; (2) plasma-edge modelling and theory; (3) surface physics; and (4) materials technology for in-vessel components and the first wall. The report which follows is divided into four major sections, one for each of these topics.

30026 **(UCRL—15583) AR coating with high damage threshold on SiO_2 glass. Final report.** Toratani, H.; Kanamori, C.; Nakajima, S.; Nakagawa, K.; Izumitani, T. (Hoya Optics, Inc., Fremont, CA (USA)). 12 Sep 1983. Contract W-7405-ENG-48. 14p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE84011063.

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The following experimental results are shown: (1) uniformity of AR coatings on Optosil and Sprasil provided by LLNL; (2) relation between cleaning methods and properties of AR coatings; (3) baking and sintering conditions of gel-derived films; (4) heat treatment of AR coating in O_2 flow.

30027 **(UCRL—90033) Nova laser alignment control system.** Van Arsdall, P.J.; Holloway, F.W.; McGuigan, D.L.; Shelton, R.T. (Lawrence Livermore National Lab., CA (USA)). 29 Mar 1984. Contract W-7405-ENG-48. 29p. (CONF-8404124—4). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE84010992.

From SPIE technical symposium; Arlington, VA, USA (29 Apr 1984).

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Alignment of the Nova laser requires control of hundreds of optical components in the ten beam paths. Extensive application of computer technology makes daily alignment practical. The control system is designed in a manner which provides both centralized and local manual operator controls integrated with automatic closed loop alignment. Menudriven operator consoles using high resolution color graphics displays overlaid with transport touch panels allow laser personnel to interact efficiently with the computer system. Automatic alignment is accomplished by using image analysis techniques to determine beam references points from video images acquired along the laser chain. A major goal of the design is to contribute substantially to rapid experimental turnaround and consistent alignment results. This paper describes the computer-based control structure and the software methods developed for aligning this large laser system.

30028 **(UCRL—90191) Low level signal data acquisition for the MFTF-B superconducting magnet system.** Montoya, C.R. (Lawrence Livermore National Lab., CA (USA)). 28 Mar 1984. Contract W-7405-ENG-48. 11p. (CONF-8404138—1). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE84011047.

From 8. national engineering symposium of the Mexican American Engineering Society; Albuquerque, NM, USA (11 Apr 1984).

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Acquisition of low level signals from sensors mounted on the superconducting magnets in the Tandem Mirror Fusion Test Facili-

ty (MFTF-B) impose very strict requirements on the magnet signal conditioning and data acquisition system. Of the various types of sensors required, thermocouples and strain gages produce very low level outputs. These low level outputs must be accurately measured in the harsh environment of slowly varying magnetic fields, cryogenic temperatures, high vacuum, 80 kV pulse power, 60 Hz, 17 MHz and 28, 35, and 56 GHz electrical noise and possible neutron radiation. Successful measurements require careful attention to grounding, shielding, signal handling and processing in the data acquisition system. The magnet instrumentation system provides a means of effectively measuring both low level signals and high level signals from all types of sensors. Various methods involved in the design and implementation of the system for signal conditioning and data gathering will be presented.

30029 **(UCRL—90246-Rev.1) Heavy ion inertial fusion: interface between target gain, accelerator phase space and reactor beam transport revisited.** Barletta, W.A.; Fawley, W.M.; Judd, D.L.; Mark, J.W.K.; Yu, S.S. (Lawrence Livermore National Lab., CA (USA); Lawrence Berkeley Lab., CA (USA); Stanford Linear Accelerator Center, CA (USA)). 22 Feb 1984. Contract W-7405-ENG-48. 15p. (CONF-840142—11-Rev.1). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE84011048.

From International symposium on heavy ion accelerators and their applications to inertial fusion; Tokyo, Japan (23 Jan 1984).

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Recently revised estimates of target gain have added additional optimistic inputs to the interface between targets, accelerators and fusion chamber beam transport. But it remains valid that neutralization of the beams in the fusion chamber is useful if ion charge state $Z > 1$ or if > 1 kA per beamlet is to be propagated. Some engineering and economic considerations favor higher currents.

30030 **(UCRL—90338) Magnetic fusion: planning for the future.** Fowler, T.K. (Lawrence Livermore National Lab., CA (USA)). 7 Feb 1984. Contract W-7405-ENG-48. 29p. (CONF-840285—1). NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE84010989.

From Committee on international cooperation in magnetic fusion of the National Research Council; Livermore, CA, USA (7 Feb 1984).

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A brief review of international cooperation in the fusion program is given. The author shares his views on the technical prospects and future potential of fusion as a practical energy source. (MOW)

30031 **(UCRL—90711) Generalized laser filamentation instability coupled to cooling instability.** Liang, E.P.; Wong, J.; Garrison, J. (Lawrence Livermore National Lab., CA (USA)). 24 Apr 1984. Contract W-7405-ENG-48. 6p. (CONF-8406115—1). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE84011069.

From 17. AIAA fluid dynamics, plasmadynamics and laser conference; Snowmass, CO, USA (25 Jun 1984).

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We consider the propagation of laser light in an initially slightly nonuniform plasma. The classical dispersion relation for the laser filamentation growth rate (see e.g., B. Langdon, in the 1980 Lawrence Livermore National Laboratory Laser Program Annual Report, pp. 3-56, UCRL-50021-80, 1981) can be generalized to include other acoustical effects. For example, we find that the inclusion of potential imbalances in the heating and cooling rates of the ambient medium due to density and temperature perturbations can cause the laser filamentation mode to bifurcate into a cooling instability mode at long acoustic wavelengths. We also attempt to study semi-analytically the nonlinear evolution of this and related instabilities. These results have wide applications to a variety of chemical gas lasers and phenomena related to laser-target interactions (e.g., jet-like behavior).

30032 **Vortex shedding due to laser ablation.** Emery, M.H.; Gardner, J.H.; Boris, J.P.; Cooper, A.L. (Laboratory for Computational Physics, Naval Research Laboratory, Washington, DC 20375). *Physics of Fluids;* **27**: No. 5, 1338-1340(May 1984).

An investigation of laser-driven targets shows the generation and subsequent shedding of strong vortex structures from the ablation layer whenever the density and pressure profiles become noncollinear. It is shown here that vortex shedding explains the inhibited linear Rayleigh—Taylor growth, the short-wavelength cutoff, dynamic stabilization and clarifies the role of the Kelvin—Helmholtz roll-up.

30033 **Reduced-aspect-ratio stellarator reactors.** Hitchon, W.N.G. (Torsatron/Stellarator Lab., Wisconsin Univ., Madison (USA)). *Nuclear Fusion;* **24**: No. 1, 91-102(Jan 1984).

The extent to which the size of a modular stellarator reactor may be reduced is investigated by means of an analytic model of the reactor. The various means employed include varying the blanket/shield thickness, the power output and the wall loading. An optimum design is found, the major radius of which tends to be insensitive to changes in these quantities, although a decrease in the power output leads to a rather smaller decrease in reactor dimensions, as would be expected. Varying the plasma beta at fixed (iota/2π)^{2}epsilon or, alternatively, increasing the rotational transform per field period, may, however, allow configurations with fewer field periods to be accessed which have a substantially smaller major radius than the 'standard case' adopted. The magnetics of various configurations required by the model are checked by field line following and the performance claimed is shown to be relatively easily achieved. Costs of two promising configurations are estimated; these designs are found to be highly competitive with other conceptual fusion reactors in terms of cost, as well as requiring less advanced technologies.

30034 **Ab initio calculations of the charge state of a fast heavy ion stopping in a finite temperature target.** Bailey, D.; Lee, Y.T.; More, R.M. (University of California, Lawrence Livermore National Laboratory (U.S.A.)). *Journal de Physique (Paris), Colloque;* 149-158(Nov 1983). (CONF-830354—).

From International workshop on atomic physics for ion driven fusion; Paris, France (21 Mar 1983).

We present a calculation of the time dependent charge state of a heavy projectile traversing a finite temperature target. The calculation uses an average-atom model to integrate the rate equations.

30035 **Current status of calculations and measurements of ion stopping power in ICF plasmas.** Mehlhorn, T.A.; Peek, J.M.; McGuire, E.J.; Olsen, J.N. (Sandia National Laboratories, Albuquerque, N.M. (U.S.A.)); Young, F.C. (Naval Research Laboratory, Washington, D.C. (U.S.A.)). *Journal de Physique (Paris), Colloque;* 39-66(Nov 1983). (CONF-830354—).

From International workshop on atomic physics for ion driven fusion; Paris, France (21 Mar 1983).

More precise stopping power models for use in ICF target design need to be developed. The light ion beam ICF program is now moving into a phase where "ad hoc" scaling of certain key physics parameters in the stopping power models is no longer sufficient. Our goal is to predict ion ranges in ICF targets to within about 10-20%. A verified stopping power model is also essential in diagnosing target irradiation intensities; such data can only be inferred by target response. Presently, our area of primary concern involves calculating the stopping power of the bound electrons of partially ionized atoms. One bound electron stopping power model that we are investigating uses the local oscillator model along with Hartree-Fock-Slater atomic charge density profiles to calculate I(Z,q,E), a generalized average ionization potential for the target electrons. This method is being studied systematically to look for deficiencies in the underlying physics model, especially at low projectile velocities. Another procedure uses the Generalized Oscillator strength model to calculate the bound electron stopping. Experimental measurements of enhanced stopping power in ICF plasmas

at the 0.3 TW/cm² level have been reported by the Naval Research Laboratory. Further experiments at Sandia are aimed at extending this data base both to higher ionization states and to higher-Z targets using a 1.2 TW/cm² proton beam on the PROTO-I accelerator.

30036 **Design criteria for afterheat removal in fusion power plants.** Kastenberg, W.E. (University of California Los Angeles, CA 90024). *Transactions of the American Nuclear Society;* **45**: 183-184(Oct 1983). (CONF-831047—).

From American Nuclear Society winter meeting; San Francisco, CA, USA (30 Oct 1983).

30037 **Shock propagation through the Cascade ICF reactor Li_2O-pebble blanket.** Pitts, J.H. (Lawrence Livermore National Lab. P.O. Box 808 Livermore, CA 94550). *Transactions of the American Nuclear Society;* **45**: 184-185(Oct 1983). (CONF-831047—).

From American Nuclear Society winter meeting; San Francisco, CA, USA (30 Oct 1983).

30038 **Environmental considerations of LOTRIT.** Ragheb, M.; Miley, G.H.; Stubbins, J. (University of Illinois Urbana, IL 61801). *Transactions of the American Nuclear Society;* **45**: 177-179(Oct 1983). (CONF-831047—).

From American Nuclear Society winter meeting; San Francisco, CA, USA (30 Oct 1983).

30039 **Heat transfer performance of a solid breeder blanket: Comparison of TRIO-01 experimental data with model.** Misra, B.; Clemmer, R.G.; Finn, P.A. (Argonne National Laboratory 9700 S. Cass Avenue Argonne, IL 60439). *Transactions of the American Nuclear Society;* **45**: 176-177(Oct 1983). (CONF-831047—).

From American Nuclear Society winter meeting; San Francisco, CA, USA (30 Oct 1983).

30040 **Thermal analysis of the TFTR vacuum vessel.** Fixler, S.Z.; Bialek, J.; Gilchrist, G.W. (Grumman Aerospace Corporation Bethpage, NY 11714). *Transactions of the American Nuclear Society;* **45**: 175-176(Oct 1983). (CONF-831047—).

From American Nuclear Society winter meeting; San Francisco, CA, USA (30 Oct 1983).

30041 **Tritium catalyzed deuterium (TCD) tokamaks.** Greenspan, E.; Miley, G.H. (University of Illinois Urbana, IL 61801). *Transactions of the American Nuclear Society;* **45**: 173-175(Oct 1983). (CONF-831047—).

From American Nuclear Society winter meeting; San Francisco, CA, USA (30 Oct 1983).

30042 **Fissionable blankets for inertial confinement fusion production of tritium.** Pendergrass, J.H.; Battat, M.E.; Thayer, G.R. (Los Alamos National Laboratory P.O. Box 1663 Los Alamos, NM 87545). *Transactions of the American Nuclear Society;* **45**: 181-182(Oct 1983). (CONF-831047—).

From American Nuclear Society winter meeting; San Francisco, CA, USA (30 Oct 1983).

30043 **A new neutron-feedback ICF driver.** Miley, G.H.; Elsayed-Ali, H.; Zedicker, M. (University of Illinois Urbana, IL 61801). *Transactions of the American Nuclear Society;* **45**: 180-181(Oct 1983). (CONF-831047—).

From American Nuclear Society winter meeting; San Francisco, CA, USA (30 Oct 1983).

30044 **Neutron measurements and radiation damage calculations for fusion materials studies.** Greenwood, L.R. (Argonne National Laboratory 9700 S. Cass Avenue Argonne, IL 60439). *Transactions of the American Nuclear Society;* **45**: 225-226(Oct 1983). (CONF-831047—).

From American Nuclear Society winter meeting; San Francisco, CA, USA (30 Oct 1983).

30045 **Improved superconducting magnet wire.** Schuller, I.K.; Ketterson, J.B. (to Dept. of Energy). US Patent Application 6-523,990. 16 Aug 1983. 7p. Contract W-31-109-ENG-38.

This invention is directed to a superconducting tape or wire composed of alternating layers of copper and a niobium-containing superconductor such as niobium of NbTi, Nb_3Sn or Nb_3Ge. In general, each layer of the niobium-containing superconductor has a thickness in the range of about 0.05 to 1.5 times its coherence length (which for Nb_3Si is 41 A) with each copper layer having a thickness in the range of about 170 to 600 A. With the use of very thin layers of the niobium composition having a thickness within the desired range, the critical field (H/sub c/) may be increased by factors of 2 to 4. Also, the thin layers of the superconductor permit the resulting tape or wire to exhibit suitable ductility for winding on a magnet core. These compositions are also characterized by relatively high values of critical temperature and therefore will exhibit a combination of useful properties as superconductors.

30046 **Method of enhancing selective isotope desorption from metals.** Knize, R.J.; Cecchi, J.L. (to Dept. of Energy). US Patent Application 6-517,477. 26 Jul 1983. 10p. Contract AC02-76CH03073.

This invention relates generally to the field of gas desorption from metals; and, more particularly, to a method of enhancing the selective desorption of a particular isotope of a gas from metals. Enhanced selective desorption is especially useful in the operation of fusion devices.

30047 **Theoretical and experimental progress in tokamak plasma confinement.** Sigmar, D.J. (Oak Ridge National Lab., TN (USA)). pp 18-57 of Information meeting. Current aspects of fusion research. Vienna, Austria; Verlag der Oesterreichischen Akademie der Wissenschaften (1983). (In German)(CONF-8303153—).

From Current aspects of fusion engineering information meeting; Vienna, Austria (3 Mar 1983).

A review is given in six chapters on current trends and achievments of tokamak research in USA. 1. Introduction 2. A recapitulation of the tokamak principle. 3. New records for beta; a new operational mode (H-mode) in Divertor plasmas. 4. Dependence of achievable poloidal βsub(E) as well as of the energy confinement time tau sub(E) on the heating power as resulting from a) tangential neutral particle heating in the ISX-B tokamak, b) normal neutral particle heating in the TDX tokamak. 5. Report on direct current drive through Lower Hybrid Resonance radio frequency in Alcator C and in PLT. 6. First operation of TFTR D-T experiment in Princeton.

30048 **Development of imploding liner systems for the NRL LINUS Program.** Turchi, P.J.; Burton, R.L.; Cameron, J.; Cooper, A.L.; Ford, R.D.; Jenkins, D.J.; Lanham, R. (Naval Research Laboratory, Washington, DC 20375). pp 881-889 of Energy storage, compression, and switching. Nardi, V.; Bostick, W.H.; Sahlin, H. New York, NY; Plenum Publishing Corp. (1983). (CONF-751247—).

From Colloquium on thermal insulators at high temperature; Paris, France (3 Dec 1975).

This chapter reports that the basic thrust of the liner implosion research at the Naval Research Laboratory for the LINUS program has been the design, development and characterization of liner implosion techniques that have the required properties of safety, reproducibility and scalability for both near-term plasma compression experiments and eventual fusion reactor applications. Discusses early work; initial NRL LINUS activities; solid liner experiments on the 540 kJ SUZY II capacitor bank; liquid liner implosions on SUZY II; piston-driven liner implosions; and some new directions.

30049 **General principles of inertial confinement.** Haas, R.A. (Univ. of California Lawrence Livermore National Lab. Livermore, CA). pp 71-136 of Atomic and molecular physics of controlled thermonuclear fusion. Joachain, C.J.; Post, D.E. New York, NY; Plenum Publishing Corp. (1983). (CONF-820731—). Contract W-7405-ENG-48.

From North Atlantic Treaty Organization Advanced Study Institute conference on atomic and molecular processes in controlled thermonuclear research; Palermo, Italy (19 Jul 1982).

This chapter considers the target, driver and reactor aspects of the inertial confinement fusion (ICF) concept. Discusses the energetics of an inertial fusion power plant; requirements on target energy gain (thermonuclear energy released/driver input energy); driver efficiency; general principles of ICF; the relationship between target gain and driver energy; the various target and driver options; performance characteristics of laser and ion beam driven targets; the nominal performance requirements for inertial confinement fusion drivers; inertial fusion reactor concepts; and laser and ion beam driver technologies. Points out that in ICF, the reactor and driver are physically separated, leading to many novel reactor concepts. Notes that because of their ability to flexibly provide the driving conditions, lasers have been used extensively to experimentally explore the feasibility of ICF. Concludes that the successful development of inertial fusion depends on the development of several diverse technologies with regard to targets, drivers, reactor chambers, etc.

30050 **Non-fossil energy for the production of synthetic fuels from Coal I. Fusion reactor with high temperature steam electrolyzer and gasifier.** Steinberg, M. (Department of Nuclear Energy Department of Energy and Environment Brookhaven National Laboratory Upton, New York). *Alternative Energy Sources;* 6: 37-51(Dec 1980). (CONF-801210—).

From 3. Miami international conference on alternative energy sources; Miami Beach, FL, USA (15 Dec 1980).

Fusion reactors could displace a large amount of the coal needed for synthetic fuel production. A unique feature of a fusion reactor is that it can potentially supply high temperature steam in the range of 1000° to 1500°C in a continuous manner. The high temperature steam would be obtained by internal heating of a refractory containing blanket section which would absorb the neutrons from the plasma. The water process stream would absorb the heat from the refractory, producing high temperature steam. The high temperature steam could be electrolyzed in a high temperature electrolyzer (HTE) and converted in a high temperature steam gasifier (HTSG) with coal. The HTE has the advantage of producing H_2 at 50 to 70% overall thermal efficiency. The HTSG has the advantages of eliminating the need for oxygen and excess coal to provide the endothermic heat of reaction for the water gas reaction. No switching valves or heat transfer surfaces are needed. Applying the fusion reactor in combination with HTE and HTSG for conversion of coal to synthetic natural gas (SNG) and liquid gasoline the efficiency of utilization of coal could be improved from 1.6 to 3.2 times for SNG and from 1.8 to 2.4 times for liquid fuel. The major advantages of the fusion reactor HTE-HTSG system for synthetic fuels includes (1) an increase in utilization of the coal resource by a factor of 2 to 3 respectively for liquid and gas production (2) a 2-to 3-fold reduction in the environmental pollution factors which include (a) reduced mining hazards, (b) reduced release of the toxic agents, S, N and ash and (c) reduced buildup of CO_2 in the atmosphere which could lead to a catastrophic climatic "greenhouse" effect.

30051 **HYFIRE: A tokamak-high-temperature electrolysis system.** Fillo, J.A.; Benenati, R.; Horn, F.; Issacs, H.; Lazareth, O.W.; Makowitz, H.; Powell, J.R.; Steinberg, M.; Usher, J. (Department of Nuclear Energy Brookhaven National Laboratory Upton, New York). *Alternative Energy Sources;* 5: 173-184(Dec 1980). (CONF-801210—).

From 3. Miami international conference on alternative energy sources; Miami Beach, FL, USA (15 Dec 1980).

Brookhaven National Laboratory (BNL) is carrying out a comprehensive conceptual design study called HYFIRE of a commercial fusion Tokamak reactor, high-temperature electrolysis system. The study is placing particular emphasis on the adaptability of the STARFIRE power reactor to a synfuel application. The HYFIRE blanket must perform three functions: a) provide high-temperature (about 1400°C) process steam at moderate pressures (in the range of 10 to 30 atm) to the high-temperature electrolysis (HTE) units; b) provide high-temperature (about 700-800°C) heat to a thermal power cycle for generation of electricity to the HTE units; and c) breed enough tritium to sustain the D-T fuel cycle. In addition to thermal energy for the decomposition of steam into its constituents H_2 and O_2, electrical input is required. Fourteen hundred degree steam coupled with 40% power cycle efficiency results in a process efficiency (conversion of fusion energy to hydrogen chemical energy) of 50%.

30052 **Inertial fusion and energy production.** Ahlstrom, H.G. (University of California, Lawrence Livermore National Laboratory, Livermore, California). *Alternative Energy Sources;* 5: 147-152(Dec 1980). (CONF-801210—).

From 3. Miami international conference on alternative energy sources; Miami Beach, FL, USA (15 Dec 1980).

Inertial Confinement Fusion (ICF) has strong prospects of becoming a real energy option. The fuel supply is practically inexhaustible. The present paper summarizes the accomplishments of the last decade in the development of ICF technology. Although a real breakthrough is still to come, important developments have occurred both in the laser and ion beam technology, and in the reactor system design.

99 GENERAL AND MISCELLANEOUS

REFER ALSO TO CITATION(S) 28504

30053 **(ANL—84-26) Chemical Technology Division annual technical report, 1983.** (Argonne National Lab., IL (USA)). Apr 1984. Contract W-31-109-ENG-38. 187p. NTIS, PC A09/MF A01. Order Number DE84011797.

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Highlights of the Chemical Technology (CMT) Division's activities during 1983 are presented. In this period, CMT conducted research and development in the following areas: (1) advanced batteries - mainly lithium alloy/metal sulfide, sodium/sulfur, and sodium/alkali nitrate for electric vehicles; (2) aqueous batteries - mainly improved lead-acid and nickel/iron for electric vehicles; (3) advanced fuel cells with molten carbonate or solid oxide electrolytes for use by electric utilities; (4) coal utilization, including the heat and seed recovery technology for coal-fired magnetohydrodynamics plants and the technology for pressurized fluidized-bed combustors; (5) methodologies for recovery of energy from municipal waste; (6) solid and liquid desiccants that allow moisture to be removed with a minimum of energy; (7) cycle technology related to proof of breeding for a light water reactor, sodium technology for liquid metal fast breeder reactors, and nuclear waste management; (8) physical chemistry of fission products under accident conditions in a light water reactor and of reactor materials (e.g., UO_2) in a liquid metal fast breeder reactor to very high temperatures; and (9) fusion technology, primarily experimental and design studies for the breeder blanket. The Division also has a program in basic energy sciences, which includes research on: (1) fluid catalysis involving carbon monoxide hydrogenation and methanol homologation; (2) the solution chemistry of transition-metal containing minerals and related strategic materials; (3) sulfur and nitrogen chemistry in the environment; (4) the thermodynamic properties of inorganic materials; and (5) the kinetics and mechanisms of fast electrochemical reactions at electrode-electrolyte interfaces. The Division continued to be the major user of the services provided by the central Analytical Chemistry Laboratory at ANL.

30054 **(DOE/OR/21400—T8) Role of national laboratories in materials science research.** Postma, H. (National Research Council, Washington, DC (USA)). 16 Apr 1984. Contract AC05-84OR21400. 14p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE84011659.

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One of the major activities is to support the national missions in fusion, fission, fossil, and solar energy, as well as energy-conserving new materials. A second major activity involves basic research in support of the technologies. There is also long-term multidisciplinary basic research, and construction and operation of major facilities. The national laboratories provide a framework for carrying out all these activities. Examples from Oak Ridge and Argonne are given. (DLC)

30055 **(ORNL—6037) Chemistry Division annual progress report for period ending January 31, 1984.** (Oak Ridge National Lab., TN (USA)). May 1984. Contract AC05-84OR21400. 225p. NTIS, PC A10/MF A01; 1; GPO Dep. Order Number DE84012043.

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Progress is reported in the following fields: coal chemistry, aqueous chemistry at high temperatures and pressures, geochemistry, high-temperature chemistry and thermodynamics of structural materials, chemistry of transuranium elements and compounds, separations chemistry, elecrochemistry, catalysis, chemical physics, theoretical chemistry, nuclear waste chemistry, chemistry of hazardous chemicals, and thermal energy storage.

9901 Management

30056 **(DOE/ER—0165/1) Nuclear engineering enrollment and degrees, 1983.** Sweeney, D.H.; Shirley, D.L. (Oak Ridge Associated Universities, Inc., TN (USA)). May 1984. Contract AC05-76OR00033. 76p. NTIS, PC A05/MF A01; GPO Dep. Order Number DE84010967.

This report presents data on the number of students enrolled in the fall of 1983 and the degrees awarded in academic year 1982-83 from 75 US institutions offering degree programs in nuclear engineering or in other engineering disciplines with a nuclear option sufficient to equip graduates to function as nuclear engineers. The report includes historical survey data for the last decade and provides information such as trends by degree level and program option, foreign national student participation, female and minority student participation, and placement of graduates. Also included is a listing of the universities by type of program and number of students.

30057 **(DOE/OR/00033—T62) Guide to computer-based training.** (Oak Ridge Associated Universities, Inc., TN (USA)). Jan 1984. Contract AC05-76OR00033. 108p. NTIS, PC A06/MF A01; GPO Dep. Order Number DE84012244.

The Guide is intended to (1) describe computer-based training; (2) help you analyze what role the computer might play in your training program; (4) offer you criteria for making decisions about types of systems, hardware, and software; (5) help you determine how you might obtain CBT (computer based training); (6) suggest additional resources for you to investigate; and (7) describe some experiences of DOE contractors and other federal organizations with CBT.

30058 **(DOE/OR/21354—T2) Analysis of annual assistance issues: City of Oak Ridge, Anderson, and Roane Counties, Tennessee. Final report.** Freeman, T.A.; Harvey, E.C.; Lyman, T.R.; Ousterhout, D.G. (SRI International, Menlo Park, CA (USA)). Feb 1984. Contract AC05-83OR21354. 93p. NTIS, PC A05/MF A01; 1; GPO Dep. Order Number DE84011601.

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This study of community assistance issues and evaluation of local self-sufficiency efforts is designed to inform DOE prior to expiration of the current contracts in September 1984. To aid in those decisions, the report follows in three sections. Section II looks at the changing character of the Oak Ridge area, the effects of self-sufficiency efforts, and the implications of these effects for continued federal assistance. Section III sets forth macro DOE policy choices regarding community assistance and a number of implementation alternatives, including their strengths and their limitations. Section IV summarizes the issues, the policy options, and the implementation alternatives. Finally, an appendix contains additional supporting data that should be useful as DOE considers its course of action. 2 figures, 40 tables.

30059 **(DOE/TIC—3398) DOE patents available for licensing: a bibliography.** Thoeming, G.H. (ed.). (USDOE Technical Information Center, Oak Ridge, TN). Jun 1982. 234p. NTIS, PC A11/MF A01. Order Number DE82012479.

Abstracts and indexes are provided for 1344 DOE patents or patent applications concerning any aspect of energy production, conservation, and utilization. The entries are arranged by subject category as shown in the table of contents. The bibliography covers the period from January 1974 through December 1980.

30060 **(INIS-mf—8927) 60 years of the Institute for Research, Production and Application of Radioisotopes.** Chorvat, K. (ed.). (Ustav pro Vyzkum, Vyrobu a Vyuziti Radioisotopu, Prague (Czechoslovakia)). 1981. 98 p.p. (In Russian). NTIS (US Sales Only), PC A05/MF A01. Order Number DE84780240.

The Institute for Research, Production and Application of Radioisotopes was established in 1919. In 1980 the Institute moved to new buildings in Prague-Malesice. Its activities cover three main areas, viz.: the production of labelled compounds, sealed sources and radionuclide standards; specialized services for the whole country; research into the application of radionuclides and ionizing radiations. (Ha).

30061 (INIS-mf—8927, pp 9-17) **History and presence of Institute for Research, Production and Applications of Radioisotopes.** Hokr, I. 1981. (In Russian). NTIS (US Sales Only), PC A05/MF A01. Order Number DE84780240. TI84780240

In 60 years of the Institute for Research, Production and Application of Radioisotopes 1919-1979.

Current responsibilities of the Institute cover three main areas, i.e., the production, specialized services for the whole country, and research. The Institute produces ^{14}C-and ^{3}H-labelled compounds, sealed sources for industrial and medical applications including sources for radioisotope fire alarms, radioactive light sources and radionuclide standards. Services include central distribution of radioactive materials including inspection, central evaluation of personnel dosemeters, applications of tracer techniques in different fields, collection and storage of low-level wastes. Research is mostly focused on the further development of production and services provided by the Institute. In addition, it includes the study of radiation technologies and metrology of radionuclides. (Ha).

30062 (INIS-mf—8927, pp 19-28) **Scientific and technical development and international cooperation.** Chorvat, K.; Dedek, V. 1981. (In Russian). NTIS (US Sales Only), PC A05/MF A01. Order Number DE84780240. TI84780240

In 60 years of the Institute for Research, Production and Application of Radioisotopes 1919-1979.

A brief list is presented of research projects implemented by the Institute between 1959 and 1978, including the wide area of international cooperation, mainly with CMEA countries. (B.S.).

30063 **(LBL-PUB—426-Rev.) Guide to user facilities at the Lawrence Berkeley Laboratory.** (Lawrence Berkeley Lab., CA (USA)). Apr 1984. Contract AC03-76SF00098. 20p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE84012159.

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Lawrence Berkeley Laboratories' user facilities are described. Specific facilities include: the National Center for Electron Microscopy; the Bevalac; the SuperHILAC; the Neutral Beam Engineering Test Facility; the National Tritium Labeling Facility; the 88 inch Cyclotron; the Heavy Charged-Particle Treatment Facility; the 2.5 MeV Van de Graaff; the Sky Simulator; the Center for Computational Seismology; and the Low Background Counting Facility. (GHT)

30064 **(NP—4770255) VIK annual report 1982/83.** (Vereinigung Industrielle Kraftwirtschaft (VIK) e.V., Essen (Germany, F.R.)). 1983. 57p. (In German). NTIS (US Sales Only), PC A04/MF A01. Order Number DE84770255.

This report provides some information on the activities of the Association in the year under report. The chapters are arranged according to the following main topics: 1. pollution prevention and industrial energy economy, 2. legal aspects of energy, 3. energy economy - electric power and fuels -, 4. engineering, and 5. cooperation with its associated members and public relations.

30065 **(ORAU—222) Training the occasional trainer.** Weseman, M.; McMurphy, M. (Oak Ridge Associated Universities, Inc., TN (USA)). Dec 1983. Contract AC05-76OR00033. 141p. NTIS, PC A07/MF A01; 1; GPO Dep. Order Number DE84011379.

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The purpose of this manual is to assist once-in-a-while or occasional trainers in improving their effectiveness as trainers. This manual is written for the full-time, professional trainer to use as a resource in conducting a short course (one-half to three days) for occasional instructors in the fundamentals of training. The introductory chapter discusses the need for training the occasional trainer. Each following chapter deals with an individual concept or aspect of training-methods, instructional objectives, evaluation, etc. and contains an Instructor's Guide (background information, theory, examples) and a Course guide (lecture notes, handouts, suggested activities). It is written in a modular format so that users can select only those modules, or parts of modules, that meet the specific needs of their target audience of occasional trainers. The basic philosophy of this manual is that training should be learner-oriented and should involve the learners as much as possible. This course can be presented in whole or in part depending on the needs of the audience and the time available. The complete course requires two days. A one-day course, and a half-day course are also possible.

30066 **(ORNL/TM—8923) ORNL ALPHAMA MIS programmer's manual.** Grubb, J.W.; Lovin, J.K.; Haese, R.L. (Oak Ridge National Lab., TN (USA)). May 1984. Contract AC05-84OR21400. 86p. NTIS, PC A05/MF A01; 1; GPO Dep. Order Number DE84011724.

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This manual is a reference for programmers resonsible for the software maintenance of ALPHAMA. ALPHAMA is a part of the ALPHA Management Information System (MIS), which is a general-purpose MIS. The purpose of ALPHAMA is to provide the capability to make additions, deletions, or corrections to a data base. The manual also explains how to set up an ALPHA data base and the associated tables and reference files.

9902 Mathematics And Computers

REFER ALSO TO CITATION(S) 27918, 27925, 28985, 30057, 30066

30067 **(AD-A—137774/6) High performance parallel computing. Final report 1 Jan-31 Dec 82.** Browne, J.C. (Texas Univ., Austin (USA). Dept. of Computer Sciences). 31 Dec 1982. 13p. NTIS, PC A02/MF A01.

The three major research areas have been parallel structuring of computations, basic software for support of parallel computations and parallel architectures and supporting hardware. The work on parallel structuring of computations falls into three categories. First of these is parallel structuring of complete programs or applications. The example to be discussed below is a Monte Carlo simulation of particle movement. The second category is parallel formulation of specific numerical algorithms. The third topic is parallel formulations of non-numeric algorithms, in particular radix sorting. Design, development and analysis of basic software for parallel computing has received major emphasis. Basic software for support of parallel computations on reconfigurable network architectures is an almost entirely unstudied problem area. The third major area is continuing development of parallel architectures and hardware support for parallel architectures in the context of the Texas Reconfigurable Array Computer.

30068 **(AD-A—137883/5) Harmony theory: a mathematical framework for stochastic parallel processing. Technical report.** Smolensky, P. (California Univ., San Diego, La Jolla (USA). Inst. for Cognitive Science). Dec 1983. 21p. NTIS, PC A02/MF A01.

Given a set of stimuli presenting views of some environment, how can one characterize the natural modules or objects that compose the environment. Should a given set of items be encoded as a collection of instances or as a set of rules. Restricted formulations of these questions are analyzed within a new mathematical framework that describes stochastic parallel computation. An algorithm is given for simulating this computation once schemas encoding the modules of the environment have been selected. The concept of computational temperature is introduced. As this temperature is lowered, the system appears to display a dramatic tendency to coherently interpret input, even if the evidence for any particular interpretation is very weak.

30069 **(ANL—82-84-Rev.1) Logic Machine Architecture inference mechanisms: layer 2 user reference manual release 2.0.** Lusk, E.L.; Overbeek, R.A. (Argonne National Lab., IL (USA)). Apr 1984. Contract W-31-109-ENG-38. 129p. NTIS, PC A07/MF A01; 1; GPO Dep. Order Number DE84012115.

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Logic Machine Architecture (LMA) is a package of software tools for the construction of inference-based systems. This document is the reference manual for layer 2 of LMA. It contains the information necessary to write LMA-based systems at the level of layer 3. Such systems include theorem provers, reasoning components for expert systems, and customized deduction components for a variety of application systems.

30070 **(ANL—84-27) Automated reasoning system ITP.** Lusk, E.L.; Overbeek, R.A. (Argonne National Lab., IL (USA)). Apr 1984. Contract W-31-109-ENG-38. 60p. NTIS, PC A04/MF A01; 1; GPO Dep. Order Number DE84011795.

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This report describes a system designed to provide a portable environment for the study of automated reasoning. The system is built on the LMA automated reasoning subroutine package. This program is not part of LMA itself but illustrates the level of inference-based system that can be constructed from the LMA package of tools. It is a clause-based reasoning system supporting a wide variety of techniques which have proven valuable over the years in a long-running automated deduction research project. In addition, it is designed to present a convenient, interactive interface to its user.

30071 **(BNL—34641) Monte Carlo simulation of the microcanonical ensemble.** Creutz, M. (Brookhaven National Lab., Upton, NY (USA)). 5 Apr 1984. Contract AC02-76CH00016. 12p. (CONF-8404119—1). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE84010880.

From Workshop on gauge theory on lattice; Argonne, IL, USA (5 Apr 1984).

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We consider simulating statistical systems with a random walk on a constant energy surface. This combines features of deterministic molecular dynamics techniques and conventional Monte Carlo simulations. For discrete systems the method can be programmed to run an order of magnitude faster than other approaches. It does not require high quality random numbers and may also be useful for nonequilibrium studies. 10 references.

30072 **(CERN—83-03) CERN school of computing 1982. Proceedings.** (European Organization for Nuclear Research, Geneva (Switzerland)). 2 May 1983. 358p. (CONF-8208173—). NTIS (US Sales Only), PC A16/MF A01. Order Number DE84780234.

From CERN school of computing; Zinal, Switzerland (29 Aug 1982).

Abstracts of individual items from the proceedings were prepared separtely for the data base. (GHT)

30073 **(CONF-8404152—1) Argonne integrated heterogeneous file transfer network.** Schofield, J. (Argonne National Lab., IL (USA)). 1984. Contract W-31-109-ENG-38. 23p. NTIS, PC A02/MF A01; GPO Dep. Order Number DE84012092.

From 25. Association for Energy Systems, Operations and Programming conference; Seattle, WA, USA (30 Apr 1984).

This presentation describes the computing environment at Argonne National Laboratory and the actions underway to imple-

ment a coherent hierarchy of computing systems connected through a heterogeneous file transfer network. A major goal of the Computing Services Division is to integrate heterogeneous computing elements incrementally into a nework, with the goal of having everything somehow connected to everything else. Using standard IBM networking protocols, we have already built a full-function computer-to-computer file transfer network of IBM and DEC VAX systems. Currently, the users on the IBM MVS and VM/CMS systems can use standard IBM commands to send files and mail to DEC VAX users and output devices, and they can receive files from the DEC VAX's as if they had been sent from other IBM systems; similarly, the DEC VAX users can use standard DEC commands to send files and mail to IBM users and output devices, and they can receive files from the IBM systems as if they had been sent from other DEC VAX systems. In fact, the VAXes can exchange files and mail among themselves via the IBM NJE-based network without the need for DECnet links between the VAXes. Because this integrated heterogeneous file transfer network uses the standard IBM peer-to-peer communications protocol, all of the Laboratory's IBM and DEC computers easily communicate with the approximately 170 other computers in the Bitnet university network. Plans call for further integration of existing HP 3000 systems and future word processing systems such as Exxon, NBI, or Wang; we believe it is vitally important to provide smooth paths into this network for users of personal desktop computers. 17 references.

30074 **(DP-MS—84-40) Getting into CAD at the Savannah River Plant.** Scoggins, W.R. (Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Plant). 1984. Contract AC09-76SR00001. 15p. (CONF-8405151—2). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE84011518.

From Computer aided engineering symposium; Wilmington, DE, USA (15 May 1984).

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In 1978, the Savannah River Plant (SRP) Project Department was producing approximately 1100 new drawings and 3000 revisions per year, with a force of 30 draftsmen. Design services for the Plant were increasing due to changing programs, obsolescent equipment replacements and added security requirements. This increasing workload greatly increased the engineering drafting backlog. At the same time, many draftsmen were approaching retirement age and were to be replaced with unskilled draftsman trainees. A proposal was presented to management to acquire a Computer Aided Drafting (CAD) system to produce instrument and electrical drawings which comprised 30% of the work load.

30075 **(EGG-ED—6515) Procedures for fault tree construction/reliability analysis on the CAD system - user manual.** Rhudy, J.W. (EG and G Idaho, Inc., Idaho Falls (USA)). Apr 1984. Contract AC07-76ID01570. 35p. NTIS, PC A03/MF A01; GPO Dep. Order Number DE84011906.

This manual contains information concerning Fault Tree Construction on the EG and G Idaho, Inc, Computer-Aided Design System (CAD). The programs for fault tree construction prepared by EG and G at the Idaho National Engineering Laboratory are used on an Applicon CAD System which is compatible with the CYBER computer, to which the information will be transferred for analysis. The material herein is available on the CAD system in the form of printed messages on the screen. However, an effort has been made to include additional detail to these messages as well as to provide an off-system reference manual. The programs required to produce fault trees reside on the EG and G Applicon CAD System. Operators of the CAD require a short familiarization (~2 hrs) with the CAD system and its associated hardware before starting work. After an operator logs into the system and loads the start file, graphic symbols are added to create the fault tree. These symbols can then be manipulated to produce the final desired configuration before making a tape to transfer the file to the CYBER for analysis. Special care was taken to eliminate the need of memorization of commands to help the causal operator and to reduce the necessity of constant retraining on use of the CAD system.

30076 **(FERMILAB/TM—1255) EPICS personal computer evaluation.** Kramper, B.; MacKinnon, B. (Fermi National Accelerator Lab., Batavia, IL (USA)). Feb 1984. Contract AC02-76CH03000. 12p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE84012519.

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This document is an evaluation of five personal computers to be used as intelligent terminals on the beamline control system (EPICS). It is not intended to be a general comment on the computers themselves. Rather, it is an evaluation of these computers for a specific need. Nevertheless, this document should be useful for those considering the acquisition of a personal computer.

30077 **(HEDL-SA—3128-FP) Fundamentals of computer security.** Berting, F.M. (Hanford Engineering Development Lab., Richland, WA (USA)). 4 Apr 1984. Contract AC06-76FF02170. 6p. (CONF-8406118—1). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE84011476.

From 7. international conference of women engineers and scientists; Washington, DC, USA (17 Jun 1984).

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Computer systems managers must address the need for protecting important company information and programs used to process that information by computers. Not related to the government classified category, this data is anything that could cause loss or harm to the company if altered, destroyed, or divulged. Threats specific to computer systems, such as unauthorized access to, or improper use of such data must be addressed without spending more on protective measures than is risked. Procedures are available to estimate such risks. Actions of people pose far greater threats than fire, flood or major disasters. Protective measures, therefore, emphasize preventing people from doing harm, accidentally or maliciously, by keeping out the unauthorized, tracking the activities of the authorized, and maintaining back-up copies of everything required for essential company operations.

30078 **(LA-UR—83-3084) System information database: an automated maintenance aid.** Brice, L.; Connell, J. (Los Alamos National Lab., NM (USA)). 1984. Contract W-7405-ENG-36. 31p. (CONF-840710—2). NTIS PC A03/MF A01. Order Number DE84001725.

From National computer conference; Las Vegas, NV, USA (1 Jul 1984).

This paper is a case study of how one DP organization applied student labor and a relational DBMS in a prototyping environment to automate much of their applications systems documentation function. The capabilities, fringe benefits and future enhancements of the tool are discussed.

30079 **(LA-UR—83-3549) Improved accuracy general remapping algorithm.** Dukowicz, J.K. (Los Alamos National Lab., NM (USA)). 1984. Contract W-7405-ENG-36. 11p. (CONF-840650—1). NTIS, PC A02/MF A01; GPO Dep. Order Number DE84004320.

From 9. international conference on numerical methods in fluid dynamics; Saclay, France (25 Jun 1984).

Most numerical methods in fluid dynamics can be classified as being either Lagrangian or Eulerian. An important group of methods, however, is a combination of both. These methods generally derive from the ALE (Arbitrary-Lagrangian-Eulerian) method of Hirt et al. A computational cycle in these methods is divided into two main phases: a lagrangian phase and a rezone or remap phase (these two terms are used interchangeably). The remapping phase conservtively transfers quantities, calculated in the Lagrangian phase, from the Lagrangian mesh to some other specified mesh. For example, in a given time step the remap phase may be omitted, in which case the computation is purely Lagrangian, or the remapping may be back to the original mesh, in which case the computation is Eulerian. The remapping step, therefore, corresponds to the effect of the advection terms in Eulerian equations. It may also be viewed as a conservative interpolation procedure from one mesh to another, and so it is also useful in other more general applications, such as in adaptive mesh computations. In this paper a new method is extended to the case of a more accurate density distribution: the density distribution within a cell is allowed to be linear, while preserving the average value of density over the cell.

The orientation of this planar surface is given by the average local density gradient. Such a linear distribution, while more accurate in general, can cause undershoots or overshoots in regions of rapidly changing densities. This is avoided by placing monotonicity limits on the allowable gradients, similar to those used by Van Leer in one-dimension.

30080 **(LA-UR—84-1324) Current research in parallel microprocessing systems at Los Alamos.** Ethridge, C.D. (Los Alamos National Lab., NM (USA)). 2 May 1984. Contract W-7405-ENG-36. 6p. (CONF-8405131—5). NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE84011342.

From 6. annual ideas in science and engineering exposition and symposium; Albuquerque, NM, USA (2 May 1984).

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The Computing and Communications Division at the Los Alamos National Laboratory has designed and is building a parallel microprocessor system (PuPS) to serve as a research tool for evaluating parallel processing of large-scale scientific codes. PuPS is an experimental architecture consisting of an orthogonal array of 20 processing elements by 32 memory elements, establishing a tightly coupled, shared-memory (16-Mbyte) machine. The hardware incorporates VLSI components, such as 16-bit microprocessors, floating-point co-processors, and dynamic random access memories. The design replaces conventional MSI/SSI circuitry with programmable array logic, logic sequencers, and logic arrays. This experimental system, which is only 1 element of the parallel processing research being done by the Laboratory's Computing and Communications Division, will enable direct comparisons of speedups of algorithms for a variety of multiprocessor architectures.

30081 **(ORNL/CSD/TM—162) MAPEDIT user's manual.** Fischer, K.N. (Oak Ridge National Lab., TN (USA)). Apr 1984. Contract AC05-84OR21400. 117p. NTIS, PC A06/MF A01; 1; GPO Dep. Order Number DE84012045.

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MAPEDIT is an interactive computer graphics program used in conjunction with MAPPER [1] to add enhancements (e.g., lines, labels, and boxes) to a MAPPER plot. Annotation and other enhancements that would be difficult to place on a MAPPER plot before seeing it are easy to add using MAPEDIT. First MAPPER draws a plot on the screen of an interactive graphics terminal supported by MAPEDIT. Then MAPEDIT commands and the terminal's graphic input device (e.g., crosshair cursor controlled by thumbwheel or joystick) are used to edit the plot by adding enhancements to it. As these enhancements are made, the corresponding MAPPER commands needed to produce them are written in an output file. This output file may then be modified by a text editor, if desired, and run through MAPPER on any device that will give high-quality final output. The MAPEDIT program is currently installed on both the Computer Sciences and the Fusion Energy Division PDP-10 systems. It must be used with a Tektronix 4054 or Tektronix 4010-family terminal (excluding Tektronic 4006) or a terminal compatible with one of these, such as the DEC VT 100 equipped with the Retrographics VT 640 enhancement by Digital Engineering.

30082 **(PNL-SA—11565) User-oriented laboratory data entry computer system designed to reduce errors.** Peloquin, R.A. (Pacific Northwest Lab., Richland, WA (USA)). Feb 1984. Contract AC06-76RL01830. 7p. (CONF-840202—25). NTIS, PC A02/MF A01; GPO Dep. Order Number DE84011901.

From 17. midyear topical meeting of the Health Physics Society; Pasco, WA, USA (5 Feb 1984).

Data entry computer programs that focus on the user-system interface can reduce error, save time, and optimize personnel resources. Feed-back from the potential users during the task analysis and throughout the development stage should direct the formation of the computer code. Checking and verification of data, reduction of keystrokes, and in-place instructions are some of the techniques that should be utilized. These design principles and techniques were used during the development of ENTRY, a data entry computer program used to record data (e.g., sample weights, radiochemical analyses) for a long-term field and laboratory study. Extensive data must be collected each year from each of the more than 350 experimental plots used in the study. The data is entered on a MINC-11 microcomputer with two disk drives and less than eight kilobytes of usable memory. Despite the memory restriction, the program demonstrates a wide range of techniques which make it easy to use and consequently reduces the occurrence of errors.

30083 **(SAND—84-0142) Recommended practices for spline usage in CAD/CAM systems: CADCAM-007.** Fletcher, S.K. (Sandia National Labs., Albuquerque, NM (USA)). Apr 1984. Contract AC04-76DP00789. 17p. NTIS, PC A02; 3; GPO Dep. Order Number DE84011158.

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Sandia National Laboratories has been assigned Lead Lab responsibility for integrating CAD/CAM activities throughout the DOE Nuclear Weapons Complex (NWC) and automating exchange of product definition. Transfer of splines between CAD/CAM systems presents a special problem due to the use of different spline interpolation schemes in these systems. Automated exchange via IGES (Initial Graphics Exchange Specification, ANSI Y14.26M-1981) shows promise but does not yet provide a usable data path for NWC spline needs. Data exchange today is primarily via hard copy drawings with manual data reentry and spline recomputation. In this environment, spline problems can be minimized by following the recommended practices set forth in this report.

30084 **(SAND—84-0311) Quality Assurance (QA) procedures for computer software in Department 1510.** Fewell, M.E.; Gartling, D.K.; Korbin, C.M.; Russo, A.J.; Sisson, C.E. (Sandia National Labs., Albuquerque, NM (USA)). Feb 1984. Contract AC04-76DP00789. 27p. NTIS, PC A05/MF A01; GPO Dep. Order Number DE84012131.

This document describes the Quality Assurance (QA) plan for Department 1510 and provides all standards, requirements and participant responsibilities for its implementation.

30085 **(UCID—20064) DEC LSI-11/HP9895A software.** Castleton, R.N. (Lawrence Livermore National Lab., CA (USA)). 20 Apr 1984. Contract W-7405-ENG-48. 33p. NTIS, PC A03/MF A01; 1; GPO Dep. Order Number DE84012412.

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There is a need to exchange MSAD data between LLNL and Monsanto Research Corporation's Mound facility in Ohio. The LLNL tester is DEC LSI-11/23 based (as is all of the analysis software), and the Mound tester is HP9835 based. Data at Mound is stored on double density, double sided, HP-formatted 8 inch floppy disks. The software documented in this report makes possible the reading of these data disks by a DEC LSI-11/23 using an HP9895A disk drive.

30086 **(UCID—30184-Rev.1) Linear Systems Analysis Program user's manual, Version 2.2 (VAX/VMS).** Herget, C.J.; Tilly, D.M. (Lawrence Livermore National Lab., CA (USA)). 20 Apr 1984. Contract W-7405-ENG-48. 77p. NTIS, PC A05/MF A01; 1; GPO Dep. Order Number DE84012230.

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The computer program LSAP (Linear Systems Analysis Program) is an interactive program with graphics capability that can be used for the analysis and design of linear control systems. Nearly all classical design tools are available, including manipulation of transfer functions and generation of root locus, time response, and frequency response plots. The program is capable of working with both continuous time systems and sampled data systems. For continuous time systems, the Laplace transform is used, and for sampled data systems, the Z-transform is used. The capability of converting from a Laplace transform to a Z-transform is provided.

30087 **(UCRL—15588) Operator split methods in the numerical solution of the finite deformation elastoplastic dynamic problem.** Pinsky, P.M.; Ortiz, M.; Taylor, R.L. (California Univ., Berkeley (USA). Dept. of Civil Engineering). May 1982. Contract W-7405-ENG-48. 41p. (UCB/SESM—82/04). NTIS, PC A03/MF A01; GPO Dep. Order Number DE84011061.

The spatial formulation of the elastoplastic dynamic problem for finite deformations is considered. A thermodynamic argument leads to an additive decomposition of the spatial rate of deformation tensor and allows an operator split of evolutionary equations of the problem into elastic and plastic parts. This operator split is taken as the basis for the definition of a global product algorithm. In the context of finite element discretization the product algorithm entails, for every time step, the solution of a nonlinear elastodynamic problem followed by the application of plastic algorithms that operate on the stresses and internal variables at the integration points and bring in the plastic constitutive equations. Suitable plastic algorithms are discussed for the cases of perfect and hardening plasticity and viscoplasticity. The proposed formalism does not depend on any notion of smoothness of the yield surface and is applicable to arbitrary convex elastic regions, with or without corners. The stability properties of the global product algorithm are shown to be identical to those of the algorithm used for the integration of the nonlinear elastodynamic problem. Numerical examples illustrate the accuracy of the method.

30088 **(UCRL—53519) Adaptive finite element grid generation and extension for elliptic problems posed on unbounded domains.** Seager, M.K. (Lawrence Livermore National Lab., CA (USA)). May 1984. Contract W-7405-ENG-48. 187p. NTIS, PC A09/MF A01; GPO Dep. Order Number DE84012134.

Thesis.

This dissertation concerns the analysis, approximation and algorithmic development for the numerical solution of a second order linear elliptic boundary value problem posed on an infinite domain in R^3. In presenting the theoretical background, using the weighted Sobolev spaces introduced by Cantor [1981] the use of different boundary conditions on truncated domains was analyzed. It was proven that, under more stringent requirements on the data, the Robin boundary condition yielded solutions on the truncated domains that converged in L^2;H^1 and energy norms to the true solution on the unbounded domain. If the domain over which the error norms are calculated is fixed or the data have even faster fall off, the convergence rate increases a full degree. These asymptotic convergence results deal with the continuous solution on the bounded domain. That is to say, discretization error for an approximate solution was not considered. 53 references.

30089 **(UCRL—89915) Review of the 3rd biennial conference on real-time computer applications in nuclear and particle physics.** O'Brien, D.W. (Lawrence Livermore National Lab., CA (USA)). Oct 1983. Contract W-7405-ENG-48. 3p. (CONF-831015—48). NTIS, PC A02; 3; GPO Dep. Order Number DE84002457.

From Nuclear science symposium; San Francisco, CA, USA (19 Oct 1983).

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The topics presented at Berkeley centered on computer technologies and architecture as they effect the data-acquisition and data reduction process. Data-acquisition hardware activities were well represented with discussions of CAMAC, FASTBUS, and specialized hardware for data sorting, pipelined operations, and parallel processing. Vendors of CAMAC and FASTBUS products were present to demonstrate their systems and track new research developments and directions.

30090 **(UCRL—90392) Thinking big.** Hendrickson, C.P. (Lawrence Livermore National Lab., CA (USA)). 17 Feb 1984. Contract W-7405-ENG-48. 6p. (CONF-840458—1). NTIS, PC A02/MF A01; GPO Dep. Order Number DE84007412.

From Seminar on how to manage data and information as a resource; Washington, DC, USA (9 Apr 1984).

Superconductors have long been used at the nuclear weapons laboratories as very cost-effective computational alternatives to large numbers of nuclear tests. This paper discusses the general characteristics of these supercomputers, gives an example of the environment in which these computers are placed, and indicates what future supercomputers will look like.

30091 **Iterative three-dimensional image reconstruction from tomographic projections.** Colsher, J.G. (Lawrence Livermore Lab., CA). *Computer Graphics and Image Processing;* **6**: 513-537(1977). Contract W-7405-ENG-48.

Four algorithms are adapted to perform direct three-dimensional reconstruction from projections. The algorithms considered are summation, the Algebraic Reconstruction Technique (ART), the Simultaneous Iterative Reconstruction Technique (SIRT), and the Iterative Least Squares Technique (ILST). The concept of tomographic projections is introduced and shown to greatly simplify the calculations. This work represents the first time that these iterative algorithms have been applied to projections other than coaxial. The methods developed can be of benefit in electron microscopy, holographic interferometry, and nuclear medicine. To evaluate these methods an experimental investigation is carried out using computer-generated synthetic images. Using SIRT, direct 3-D reconstruction is shown to be superior to serial 2-D reconstruction from coaxial projections when the range of viewing angles is limited. The number of projections required for adequate reconstruction is also considered. Finally, the performance of the algorithms is compared with respect to overall similarity of the reconstruction to the original test object, effects of noise, and computer time and memory requirements.

30092 **(LA-tr—82-26) Mathematical statistics: multi-variate distributions with given boundaries.** Gumbel, E.J. Translated from *Comptes Rendus Hebdomadaires des Seances de l'Academie des Sciences ;* **246**: No. 19, 2717-2720(1958). Contract W-7405-ENG-36. 10p. NTIS, PC A02/MF A01; 1; GPO Dep. Order Number DE83000343. DE83000343

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By letting F(x) and G(y) be two probability functions and f(x) and g(y) the corresponding density functions, it has been shown that there are two-variate probability functions H(x,y) such that F(x) and G(y) are the marginal probabilities. A solution is obtained, and an analytical example is given. (WHK)

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REFER ALSO TO CITATION(S) 27990, 27991, 27992, 28490, 28523, 29690

30093 **(GAO/RCED—84-129) Department of Energy's activities to limit distribution of certain unclassified scientific and technical information.** (General Accounting Office, Washington, DC (USA). Resources, Community and Economic Development Div.). 30 Mar 1984. 26p. US General Accounting Office, PO Box 6015, Gaithersburg, MD 20760. Order Number DE84901089.

Report to The Chairman, Committee on Energy and Commerce, House of Representatives.

The Department of Energy is a major publisher of unclassified scientific and technical information. The Technical Information Center, the Department's repository, sends most of its unclassified information to the National Technical Information Service, which sells it to the public. However, some of the information is limited to distribution within the federal government because it involves nuclear safety matters; securing foreign research results; or protecting patentable, proprietary, and other information. This report describes the Department's procedures and controls for determining, distributing, and accessing unclassified information that is not made available to the public.

30094 **(ORNL/TM—8928) Review of existing environmental and natural resource data bases.** Olson, R.J. (Oak Ridge National Lab., TN (USA)). May 1984. Contract AC05-84OR21400. 75p. NTIS, PC A04/MF A01; 1; GPO Dep. Order Number DE84012039.

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Environmental and natural resource (E and NR) data are reviewed in terms of existing data bases, funding status of data bases, and long-term data base maintenance. Computerized E and NR data files and inventories of data files are described. The review is based on mail surveys, telephone contacts, and the 1983 Integrated Data Users Workshop, Data Resources in a Time of Fiscal Constraints. Twenty-four federal agency clearinghouse, referral, or data centers were identified that maintain inventories of E and NR machine-readable data files. One of the more extensive sources that can be searched to help locate available computerized data is the National Oceanic and Atmospheric Administrations National Environmental Data Referral Service (NEDRES). The NEDRES contains descriptions of over 13,500 data files. Over 130 national, computerized E and NR data bases are identified by title, geographic scale, time period, agency, and contact person. These represent a significant proportion of those files available for national or regional environmental studies. Five large integrated data base systems containing E and NR data are described. These systems provide selected data stored in compatible spatial and temporal formats with associated analysis and mapping capabilities to conduct integrated studies. The systems included DATAGRAF, GEMS, GEOECOLOGY, SEEDIS, and UPGRADE. Two systems, GEOECOLOGY and UPGRADE, are currently inactive due to funding cuts. There has been a significant reduction in the overall funding of statistical data collection within the federal government. The long-term maintenance of E and NR data includes updating files, documenting data and procedures, data base management, quality control, enhancing software/hardware capabilities, and other tasks to ensure that data will be available for analysis needs.

30095 **Fundamental understanding of matter: An engineering viewpoint.** Cullingford, H.S.; Cort, G.E. (Design Engineering Division Los Alamos National Laboratory Los Alamos, New Mexico). *Alternative Energy Sources;* **5**: 185-194(Dec 1980). (CONF-801210—).

From 3. Miami international conference on alternative energy sources; Miami Beach, FL, USA (15 Dec 1980).

Fundamental understanding of matter is a continuous process that should produce physical data for use by engineers and scientists in their work. Lack of fundamental property data in any engineering endeavor cannot be mitigated by theoretical work that is not confirmed by physical experiments. An engineering viewpoint will be presented to justify the need for understanding of matter. Examples will be given in the energy engineering field to outline the importance of our further understanding of material and fluid properties and behavior. Cases will be cited to show the effects of various data bases in energy, mass, and momentum transfer. The status of fundamental data sources will be discussed in terms of data centers, new areas of engineering, and the progress in measurement techniques. Conclusions and recommendations will be outlined to improve the current situation faced by engineers in carrying out their work.

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The notations in the final parentheses indicate the type of document, e.g., R for Report; the country of publication, e.g., US; and the language if other than English, e.g., In German. Tables of document types and country of publication codes appear after the indexes.

The title may be supplemented with additional words, or a phrase, if it appears additional information would be helpful. In cases for which the title contains little or no information related to the subject entry, it may be replaced entirely by the supplementary information. A qualifier is not always required, and in such cases the title will follow the unqualified subject descriptor.

The descriptors selected for use as subject terms are generally the names of specific materials, things, or processes. To the extent possible, a qualifier is selected to describe the properties of, or processes applied to, the subject term.

Index entries are selected to indicate the important ideas and concepts presented in a document, rather than words that may appear in the text. Within the available thesaurus terms, the most probable or logical place to look for typical information is selected. "See references" are included to guide users from synonymous terms or phrases to the descriptor selected as a subject heading for the concept. (e.g. Pipeline Quality Gas see HIGH BTU GAS). "See also references" are used to indicate where to find references to subject concepts that are narrower, broader, or related to a particular subject heading. To complete an exhaustive search of a given subject, all such headings should be reviewed. Copies of DOE/TIC-7000, the Subject Thesaurus, are available from the National Technical Information Service (NTIS), U. S. Department of Commerce, Springfield, VA 22161.

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An imaging technique in which transmission measurements of a narrow beam of rays, photons, or particles made at several different angles around an object may be used with a computer program to obtain a clear image of one plane
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Dual arm master controller concept: consolidated fuel reprocessing program, 9:27908 (R;US)

CONSUMER PRODUCTS
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AC01-78RG06405	**ICF, Inc., Washington, DC (USA)**	
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AC01-79EI10562	**Jorgenson (Dale W.) Associates, Cambridge, MA (USA)**	
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AC01-80DP30215	**BDM Corp., McLean, VA (USA)**	
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AC01-80ER10170	**JWK International Corp., Annandale, VA (USA)**	
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AC01-80ET13800	**Mitre Corp., McLean, VA (USA). METREK Div.**	
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AC01-81CS10097	**DHR, Inc., McLean, VA (USA)**	
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AC01-81CS23936	**Vitro Labs., Silver Spring, MD (USA)**	
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AC01-82CE15095	**National Center for Appropriate Technology, Butte, MT (USA)**	
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AC01-82CE30719	**Meridian Corp., Falls Church, VA (USA)**	
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AC01-82FE60036	**Mitre Corp., McLean, VA (USA). METREK Div.**	
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AC02-76CH03000	**Fermi National Accelerator Lab., Batavia, IL (USA)**	
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AC02-76ET52040	**Illinois Univ., Urbana (USA). Fusion Studies Lab.**	
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AC02-80ER10667	**Pittsburgh Univ., PA (USA). Dept. of Physics and Astronomy**	
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AC02-81ER10910	**Connecticut Univ., Storrs (USA)**	
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AC02-81ER10911	**Massachusetts Univ., Boston (USA). Dept. of Chemistry**	
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AC02-81ER40033	**The Rockefeller University, New York, New York 10021**	
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AC05-83OR21354	**SRI International, Menlo Park, CA (USA)**	
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AC05-84OR21400	**Fluor Engineers and Constructors, Inc., Houston, TX (USA)**	
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AC06-80RL10153	**Burns and Roe Industrial Services Corp., Paramus, NJ (USA)**	
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AC07-76GJ01664	**Bendix Field Engineering Corp., Grand Junction, CO (USA)**	
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AC07-76ID01570	**EG and G Idaho, Inc., Idaho Falls (USA)**	
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AC07-79ID12079	**Utah Univ., Salt Lake City (USA). Earth Science Lab.**	
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AC08-80DP40124	**Rochester Univ., NY (USA). Lab. for Laser Energetics**	
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AC11-76PN00292	**USDOE Pittsburgh Naval Reactors Office, West Mifflin, PA**	
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AC18-79ET14693	**North Carolina Univ., Chapel Hill (USA)**	
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AC21-79ET15491	**Westinghouse Electric Corp., Pittsburgh, PA (USA). Research and Development Center**	
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AC21-81MC16026	**Massachusetts Inst. of Tech., Cambridge (USA)**	
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AC21-82MC19122	**Westinghouse Electric Corp., Madison, PA (USA). Synthetic Fuels Div.**	
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AC21-82MC19163	**Scientific Design Co., Inc., New York (USA)**	
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AC22-79ET14800	**Pittsburg and Midway Coal Mining Co., Denver, CO (USA)**	
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AC22-83PC60047	**Cities Service Research and Development Co., Tulsa, OK (USA)**	
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AC22-83PC61254	**Virginia Polytechnic Inst. and State Univ., Blacksburg (USA)**	
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AC79-83BP11279	**Seton, Johnson, and Odell, Inc., Portland, OR (USA)**	
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AC96-83PO10850	**Texas A and M Univ., College Station (USA). Research Foundation**	
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AI01-76ET20320	**LaQue Center for Corrosion Technology, Inc., Wrightsville Beach, NC (USA)**	
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	9:28136	DOE/ET/20342—T11
AI01-78EV10059	**Woods Hole Oceanographic Institution, MA (USA)**	
	9:29531	WHOI—1-81
AI01-78IA06316	**Argonne National Lab., IL (USA)**	
	9:28560	DOE/IA/06316—T1
AI01-79ER10035	**Rice Univ., Houston, TX (USA)**	
	9:28093	NASA/CR—3344
AI01-81CS50006	**Purdue Univ., Lafayette, IN (USA)**	
	9:28700	DOE/NASA—0266-1
AI01-81FE00016	**Foster-Miller Associates, Inc., Waltham, MA (USA). Engineering Systems Group**	
	9:27812	DOE/FE/00016—T34
AI04-81AL16265	**Ktech Corp., Albuquerque, NM (USA)**	
	9:29159	KTECH-TR—80-01-Vol.2
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AI05-82OR21005	**National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center**	
	9:28710	DOE/NASA—1005-2
AI08-76DP00474	**Geological Survey, Denver, CO (USA)**	
	9:27960	USGS-OFR—84-23
	9:29247	USGS—474-318
AI08-76DP00539	**Environmental Protection Agency, Las Vegas, NV (USA). Environmental Monitoring Systems Lab.**	
	9:29271	DOE/DP/00539—050
AI20-82LC10870	**Army Engineer Waterways Experiment Station, Vicksburg, MS (USA). Geotechnical Lab.**	
	9:27892	DOE/LC/10870—1568
AI97-79ET44611	**Geological Survey, Denver, CO (USA). Water Resources Div.**	
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AM03-76SF00034	**Univ. of California, Los Angeles**	
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AM03-76SF00235	**Hawaii Univ., Honolulu (USA). Dept. of Physics and Astronomy**	
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AM21-79MC10513	**Harrison and Associates, Engineers, Inc., Denver, CO (USA)**	
	9:27813	DOE/MC/10513—T7

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AP19-82BC99996	Adelphi Univ., Garden City, NY (USA). Dept. of Physics and Energy Studies	
	9:27865	DOE/BC/99996—2
AS03-76DP01118	Rochester Univ., NY (USA). Dept. of Physics and Astronomy	
	9:29561	DOE/DP/01118—T1
AS05-76ER03992	Texas Univ., Austin (USA). Center for Particle Theory	
	9:29628	DOE/ER/03992—552
AS05-76ER04310	Smithsonian Institution, Rockville, MD	
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AS05-76ER05111	Houston Univ., TX (USA). Dept. of Physics	
	9:28803	DOE/ER/05111—T1
AS05-76ET20312	Oklahoma State Univ., Stillwater (USA). School of Chemical Engineering	
	9:28135	DOE/ET/20312—5
AS05-79EV10316	Tennessee Univ., Knoxville (USA)	
	9:28497	DOE/EV/10316—1-Pt.1
	9:28498	DOE/EV/10316—1-Pt.2
AS05-80ER10711	Department of Mathematics, West Virginia Institute of Technology, Montgomery, West Virginia 25136	
	9:29580	Physics of Fluids 27 NO. 5. 1114-1124 (May 1984).
	Virginia Polytechnic Inst. and State Univ., Blacksburg (USA)	
	9:29911	DOE/ER/10711—3
AS05-80ER10745	Houston Univ., TX (USA). Dept. of Chemistry	
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	9:28955	DOE/ER/10745—2
AS05-83ER13124	Rice Univ., Houston, TX (USA)	
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AS05-83ER13127	Tennessee Univ., Knoxville (USA). Dept. of Chemistry	
	9:28860	DOE/ER/13127—03
AS07-77ET28365	Colorado Geological Survey, Denver (USA)	
	9:28206	DOE/ET/28365—23
AS07-77ET28407	Idaho Univ., Moscow (USA). Idaho Water and Energy Resources Research Inst.	
	9:28194	DOE/ET/28407—4
AS07-79ET27205	Nebraska Univ., Lincoln (USA)	
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AS07-79ID12057	Texas Univ., Austin (USA). Bureau of Economic Geology	
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AS09-78EV01071	South Carolina Univ., Columbia (USA). Dept. of Biology	
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AS09-79ER10499	Univ. of Georgia, Athens	
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AS09-80ER10678	Georgia Univ., Athens (USA). Research Foundation	
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AS19-80BC10361	Tulsa Univ., OK (USA)	
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AS20-80LC10332	Utah Univ., Salt Lake City (USA)	
	9:27885	DOE/LC/10332—1582
AS20-82LC10877	Wyoming Univ., Laramie (USA). Dept. of Civil Engineering	
	9:27888	DOE/LC/10877—1567
AT03-76CS51101	Aerospace Corp., El Segundo, CA (USA). Energy Systems Group	
	9:28098	ATR—78(7695-02)-1
	Aerospace Corp., El Segundo, CA (USA)	
	9:28103	DOE/CS/51101—4
AT03-76ER10369	California Univ., Santa Barbara (USA)	
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AT03-76ER70188	Department of Chemistry, University of California, Irvine, California 92717	
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AT03-76ET51011	GA Technologies Inc., San Diego, California 92138	
	9:29960	Physics of Fluids 27 NO. 5. 1142-1147 (May 1984).
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AT03-76ET53019	Department of Physics, University of California, Los Angeles, California 90024	
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AT03-76SF70046	GA Technologies, Inc., San Diego, CA (USA)	
	9:28291	GA-A—17388
AT03-79ER10414	SRI International, Menlo Park, CA (USA)	
	9:28902	DOE/ER/10414- T2
AT03-81ER10819	California Univ., Berkeley (USA). Dept. of Chemistry	
	9:28972	DOE/ER/10819—T1
AT03-81SF11528	GA Technologies, Inc., San Diego, CA (USA)	
	9:27917	GA-A—16964
	9:27918	GA-A—17305
	9:27919	GA-A—17323
	9:27979	GA-A—16955
AT03-84ER51044	GA Technologies, Inc., San Diego, CA (USA)	
	9:29929	GA-A—17494
AT03-84ER53158	GA Technologies, Inc., San Diego, CA (USA)	
	9:29930	GA-A—17520
AT06-76ER70004	Institute of Theoretical Science, University of Oregon, Eugene, Oregon 97403	
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AT06-76ER70004	Lawrence Berkeley Lab., CA (USA)	
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AT06-76EV70022	Washington Univ., Seattle (USA). Dept. of Chemical Engineering	
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AT06-76EV75026	Univ. of Washington, Seattle	
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FC01-79RG10246	California Public Utilities Commission, San Francisco (USA)	
	9:28547	DOE/RG/10246—T1
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FC01-80CS40330	GTE Products Corp., Towanda, PA (USA). Chemical and Metallurgical Div.	
	9:28672	DOE/CS/40330—T1
FC01-83FE60149	National Inst. for Petroleum and Energy Research, Bartlesville, OK (USA)	
	9:27872	NIPER—134-PPS-84/2
FC02-80CS30379	Steel (Gerald B.), Rancho Santa Fe, CA (USA)	
	9:28147	DOE/CS/30379—T1
FC03-77CS34034	Mueller Associates, Inc., Baltimore, MD (USA)	
	9:28152	DOE/CS/34034—T1
FC03-78CS32129	New Mexico Solar Energy Inst., Las Cruces (USA)	
	9:28149	DOE/CS/32129—T1
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FC03-80RA50075	Nevada Univ., Reno (USA). Div. of Earth Sciences	
	9:28212	DOE/RA/50075—1

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	9:28213	DOE/RA/50075—2
FC05-77ET10069	Exxon Research and Engineering Co., Florham Park, NJ (USA)	
	9:27718	CONF-8405154—2
	9:27720	DOE/ET/10069—T89
FC07-79ET27055	MultiTech, Inc., Butte, MT (USA)	
	9:28231	DOE/ET/27055—10
FC07-79ID12018	Coury and Associates, Lakewood, CO (USA)	
	9:28579	DOE/ID/12018—10
FC08-79NV10032	Kansas City, City of, MO (USA). Public Works Dept.	
	9:28713	DOE/NV/10032—1
FC21-83FE60177	Western Research Inst., Laramie, WY (USA)	
	9:27883	DOE/FE/60177—1571
	9:27884	DOE/FE/60177—1590
FC21-83FE60181	North Dakota Univ., Grand Forks (USA). Energy Research Center	
	9:27710	DOE/FE/60181—1531
	9:27724	DOE/FE/60181—1574
FC22-81FE15079	Cottrell Environmental Science, Somerville, NJ (USA)	
	9:27793	CES—474
FC22-83FE60339	Southern Illinois Univ., Carbondale (USA). Coal Extraction and Utilization Research Center	
	9:27725	DOE/FE/60339—3
FG01-77ET10502	Ohio State Univ., Columbus (USA). Dept. of Civil Engineering	
	9:27821	DOE/ET/10502—T1
FG01-77ET10664	Pennsylvania State Univ., University Park (USA). Dept. of Chemistry	
	9:28028	DOE/ET/10664—T1
	9:28029	DOE/ET/10664—T2
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FG01-77ET12507	Alabama Geological Survey, University (USA)	
	9:27808	DOE/ET/12507—T1
FG01-78ET11434	Missouri Univ., Rolla (USA)	
	9:28699	DOE/ET/11434—T1
FG01-78ET20599	Washington Univ., Seattle (USA). Coll. of Forest Resources	
	9:28071	DOE/ET/20599—T1
FG01-80CS22014	US Conference of Mayors, Washington, DC	
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FG01-81CA10024	Shandiin Inst., Winslow, AZ (USA)	
	9:28063	DOE/CA/10024—T1
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FG01-81CS15059	Energy Concepts Co., Annapolis, MD (USA)	
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FG01-81ER10984	Oak Ridge National Laboratory	
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FG01-81FE30005	United Nations, New York (USA). Inst. for Training and Research	
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FG01-81RA50665	Western Governors Regional Energy Policy Office, Denver, CO (USA)	
	9:27823	DOE/RA/50665—T1
FG01-82CE25082	Life Support Systems, Erie, PA (USA)	
	9:29380	DOE/CE/25082—T1
FG02-79ET00089	Chicago Univ., IL (USA). Enrico Fermi Inst.	
	9:28181	DOE/ET/00089—3
FG02-80CS84005	California Univ., San Diego, La Jolla (USA)	
	9:29318	DOE/CS/84005—T1
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FG02-80CS84056	California Univ., Los Angeles (USA). School of Engineering and Applied Science	
	9:28177	UCLA-ENG—8310
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FG02-80CS89501	California Univ., Los Angeles (USA). School of Engineering and Applied Science	
	9:28137	UCLA-ENG—8307
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FG02-80ER10125	Michigan Univ., Ann Arbor (USA)	
	9:28515	DOE/ER/10125—T1
FG02-80R510243	Montgomery County Board of Commissioners, Dayton, OH (USA). Office of Management and Budget	
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FG03-76ER10058	California Inst. of Tech., Pasadena	
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FG03-77CS31640		
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FG03-84CE50036	Santa Clara Univ., CA (USA)	
	9:28720	DOE/CE/50036—T2
FG05-81ER10265	Auburn Univ., AL (USA)	
	9:28044	DOE/ER/10265—1
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FG06-79R000003	Washington State Energy Office, Olympia (USA)	
	9:28065	WAOENG—82-36
FG21-79MC10643	Colorado Geological Survey, Denver (USA)	
	9:27809	DOE/MC/10643—T1
FG22-80PC30223	Kentucky Univ., Lexington (USA). Dept. of Geology	
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FG22-81PC40771	USDOE Pittsburgh Energy Technology Center, PA	
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FG22-81PC40774	USDOE Pittsburgh Energy Technology Center, PA	
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FG22-81PC40783	Pennsylvania State Univ., University Park (USA). Dept. of Chemistry	
	9:27785	DOE/PC/40783—T14
FG22-81PC40799	Virginia Polytechnic Inst. and State Univ., Blacksburg (USA)	
	9:27760	DOE/PC/40799—T10
FG22-81PC40807	Southern Illinois Univ., Carbondale (USA). Dept. of Engineering Mechanics and Materials	
	9:27822	DOE/PC/40807—T10
FG22-82PC50266	Carnegie-Mellon Univ., Pittsburgh, PA (USA). Dept. of Mechanical Engineering	
	9:27826	DOE/PC/50266—6
FG22-82PC50793	Auburn Univ., AL (USA). Coal Conversion Lab.	
	9:27762	DOE/PC/50793—T6
FG22-82PC50795	Arizona Univ., Tucson (USA). Dept. of Chemical Engineering	
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FG22-82PC50799	Delaware Univ., Newark (USA). Dept. of Chemical Engineering	
	9:27764	DOE/PC/50799—T3
FG22-83PC60784	Colorado School of Mines, Golden (USA). Dept. of Chemical and Petroleum Refining Engineering	
	9:27767	DOE/PC/60784—T1
FG22-83PC60785	Kentucky Univ., Lexington (USA)	
	9:27786	DOE/PC/60785—3
FG22-83PC60796	Chicago Univ., IL (USA). Dept. of Chemistry	
	9:27768	DOE/PC/60796—3
FG22-83PC60807	Brigham Young Univ., Provo, UT (USA). Dept. of Chemistry	
	9:27787	DOE/PC/60807—3
FG45-80CS69104	Michigan Dept. of Commerce, Lansing (USA)	
	9:28153	DOE/CS/69104—5
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	9:28559	DOE/CS/69104—2
FG46-80R612054	Reeves (C. Richard), Austin, TX (USA)	
	9:28582	DOE/R6/12054—T1
FG47-80R701133	Jackson County Parks and Recreation, Blue Springs, MO (USA)	
	9:28182	DOE/R7/01133—T1

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FG47-80R701157	Vore (Roy), Pittsburg, KS (USA)	
	9:28046	DOE/R7/01157—T1
FG47-80R701161	Bachamp (Richard E.), Manhattan, KS (USA)	
	9:28155	DOE/R7/01161—T1
FG47-80R701168	Olsson Associates, Lincoln, NE (USA)	
	9:28673	DOE/R7/01168—T1
FG47-80R701170	Kruse (Richard W.), Fort Calhoun, NE (USA)	
	9:28183	DOE/R7/01170—T1
FG47-80R701173	Morton (Michael T.), Crete, NE (USA)	
	9:28156	DOE/R7/01173—T1
FG47-81R701210	Odin Associates, Cambridge, IA (USA)	
	9:28073	DOE/R7/01210—T1
FG47-81R701223	Educational Service Unit No. 9, Hastings, NE (USA)	
	9:28184	DOE/R7/01223—T1
FG47-81R701231	Creighton Univ., Omaha, NE (USA). School of Medicine	
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FG47-81R701232	Kahl (Dennis), Schuyler, NE (USA)	
	9:28157	DOE/R7/01232—T1
FG47-81R701234	Hoffman (Scott A.), Columbia, MO (USA)	
	9:28185	DOE/R7/01234—T1
FG47-81R701238	Southeast Missouri Regional Planning and Economic Development Commission, Perryville (USA)	
	9:28051	DOE/R7/01238—T1
FG47-81R701243	Kirksville, City of, MO (USA)	
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FG47-81R701248	Missouri Univ., Columbia (USA). Dept. of Agricultural Economics	
	9:28238	DOE/R7/01248—T1
FM02-82FE55014	Great Plains Gasification Associates, Detroit, MI (USA)	
	9:27723	DOE/FE/55014—T8
NAS-7-100-955902	Solarex Corp., Rockville, MD (USA)	
	9:28068	CONF-830508—29
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NAS-7-100-956615	Jet Propulsion Lab., Pasadena, CA (USA)	
	9:28072	DOE/JPL/956615—84/2
W-31-109-ENG-38	Argonne National Lab., IL (USA)	
	9:27712	ANL/FE—83-30
	9:27716	CONF-840570—4
	9:27844	ANL/EES-TM—247
	9:28001	CONF-8404143—2
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	9:28180	CONF-840622—3
	9:28188	CONF-840410—1
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	9:28299	CONF-840647—5
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	9:28360	CONF-840286—1
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	9:28396	CONF-830545—2
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	Systems Control, Inc., Palo Alto, CA (USA)	
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W-31-109-ENG-38	Department of Physics, Northeastern University, Boston, Massachusetts 02115	
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W-31-109-ENG-38	Argonne National Lab., IL (USA)	
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W-7405-ENG-26	USDOE Technical Information Center, Oak Ridge, TN	
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6920	NTIS (US Sales Only), PC A02/MF A01	DE84750634	MN -38	9:29010
6921	NTIS (US Sales Only), PC A02/MF A01	DE84750635	MN -38	9:29011
6922	NTIS (US Sales Only), PC A02/MF A01	DE84750645	MN -04	9:28966
6923	NTIS (US Sales Only), PC A03/MF A01	DE84750612	MN -21	9:29986
6924	NTIS (US Sales Only), PC A02/MF A01	DE84750647	MN -38	9:28729
6937	NTIS (US Sales Only), PC A02/MF A01	DE84750610	MN -37	9:29120
6938	NTIS (US Sales Only), PC A02/MF A01	DE84750611	MN -37	9:29121
6939	NTIS (US Sales Only), PC A02/MF A01	DE84750609	MN -37	9:29122
6954	NTIS (US Sales Only), PC A02/MF A01; 1	DE84750648	MN -04	9:28858
6955	NTIS (US Sales Only), PC A02/MF A01	DE84750640	MN -25	9:28730
6956	NTIS (US Sales Only), PC A02/MF A01	DE84750614	MN -37	9:29147
6957	NTIS (US Sales Only), PC A02/MF A01; 1	DE84750615	MN -37	9:29148
6964	NTIS (US Sales Only), PC A02/MF A01	DE84750649	MN -04	9:28967
6965	NTIS (US Sales Only), PC A02/MF A01	DE84750660	MN -04	9:27935
6971	NTIS (US Sales Only), PC A02/MF A01	DE84750666	MN -80	9:28386
6972	NTIS (US Sales Only), PC A02/MF A01; 1	DE84750627	MN -34C	9:29805
6973	NTIS (US Sales Only), PC A02/MF A01; 1	DE84750613	MN -28	9:29067
6974	NTIS (US Sales Only), PC A02/MF A01	DE84750626	MN -34D	9:29806
6975	NTIS (US Sales Only), PC A02/MF A01; 1	DE84750639	MN -79	9:28295
6976	NTIS (US Sales Only), PC A02/MF A01; 1	DE84750636	MN -80	9:28346
6977	NTIS (US Sales Only), PC A; 3	DE84750617	MN -78	9:28357
6978	NTIS (US Sales Only), PC A02/MF A01; 1	DE84750616	MN -80	9:28347
6979	NTIS (US Sales Only), PC A02/MF A01; 1	DE84750670	MN -80	9:28824
6980	NTIS (US Sales Only), PC A02/MF A01	DE84750667	MN -80	9:28348
6981	NTIS (US Sales Only), PC A02/MF A01; 1	DE84750668	MN -80	9:28349
6982	NTIS (US Sales Only), PC A02/MF A01	DE84750631	MN -80	9:28825
6983	NTIS (US Sales Only), PC A02/MF A01	DE84750638	MN -80	9:28826
6984	NTIS (US Sales Only), PC A02/MF A01; 1	DE84750669	MN -80	9:28395
6985	NTIS (US Sales Only), PC A02/MF A01	DE84750637	MN -80	9:28350
7005	NTIS (US Sales Only), PC A02/MF A01; 1	DE84750674	MN -25	9:28827
7006	NTIS (US Sales Only), PC A02/MF A01	DE84750673	MN -25	9:28731
7013	NTIS (US Sales Only), PC A02/MF A01	DE84750676	MN -25	9:28732
7017	NTIS (US Sales Only), PC A02/MF A01	DE84750675	MN -38	9:29029
7019	NTIS (US Sales Only), PC A02/MF A01	DE84750665	MN -80	9:28387

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CEND-417	*See* DOE/ET/34030-7	DE84012138	STD -78	9:28405
CERL-IR-E-187	*See* AD-A-137918/9			9:28570
CERN-83-03	NTIS (US Sales Only), PC A16/MF A01	DE84780234	MN -34	9:30072
CES-474	NTIS, PC A03/MF A01; 1 (GPO Dep.)	DE84011776	STD -90i	9:27793
CONCAWE-14/ 83	*See* PB-84-166123			9:27851
CONF-7709231-	(Marine Technology Society meeting on the economic potential of the ocean and the American Institute of Mining, Metallurgical and Petroleum Engineers, Rosalyn, VA, USA, 15 Sep 1977)			
1	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE84009336	MN -64	9:28133
CONF-780502-	(23. national SAMPE symposium, Anaheim, CA, USA, 2-4 May 1978)			
	Sci. Adv. Mater. Process Eng. Proc., 23: vp(1978)			9:28090
	Sci. Adv. Mater. Process Eng. Proc., 23: 354-365(1978)			9:28091
	Sci. Adv. Mater. Process Eng. Proc., 23: 703-711(1978)			9:28717
	Sci. Adv. Mater. Process Eng. Proc., 23: 1-9(1978)			9:28854
CONF-781133-	(AIAA conference on solar energy, Phoenix, AZ, USA, 27-29 Nov 1978)			
6	*See* DOE/CS/51101-4	TI84010531	ND -62	9:28103
CONF-8011211-	(Woods Hole Oceanographic Institute conference on sediment trap intercomparison experiment, Woods Hole, MA, USA, 13-14 Nov 1980)			
Summs.	*See* WHOI-1-81	DE84008889	MN -11	9:29531
CONF-901210-	(3. Miami international conference on alternative energy sources, Miami Beach, FL, USA, 15-17 Dec 1980)			
	Alternative Energy Sources, 7: 19-37(Dec 1980)			9:28660
	Alternative Energy Sources, 7: 39-64(Dec 1980)			9:28661
	Alternative Energy Sources, 7: 119-138(Dec 1980)			9:28662
	Alternative Energy Sources, 7: 99-117(Dec 1980)			9:28689
	Alternative Energy Sources, 7: 391-398(Dec 1980)			9:28690
	Alternative Energy Sources, 7: 399-405(Dec 1980)			9:28691
	Alternative Energy Sources, 6: 315-332(Dec 1980)			9:28692
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	Alternative Energy Sources, 9: 331-351(Dec 1980)			9:29053
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	Alternative Energy Sources, 5: 173-184(Dec 1980)			9:30051
	Alternative Energy Sources, 5: 147-152(Dec 1980)			9:30052
	Alternative Energy Sources, 5: 185-194(Dec 1980)			9:30095
CONF-811013-	(Electrochemical Society conference, Denver, CO, USA, 11-16 Oct 1981)			
	Proc. - Electrochem. Soc., 83-1: 455-471(Oct 1981)			9:28800
CONF-811157-	(IAEA specialists' meeting on examination of fuel assembly for water cooled power reactors, Tokyo, Japan, 9-13 Nov 1981)			
	See IWGFPT-12	DE84900985	MN -78	9:28264
CONF-8112102-	(Conference on scientific research and production introduction studies of light water reactor power plants, Karlovy Vary, Czechoslovakia, 1-4 Dec 1981)			
Vol.1	*See* INIS-mf-8928	DE84780241	MN -25	9:28260
Vol.2	*See* INIS-mf-8929	DE84780242	MN -25	9:28262
Vol.3	*See* INIS-mf-8930	DE84780245	MN -41	9:28263
CONF-820618-	(International conference on plasma physics, Goeteborg, Sweden, 7-21 Jun 1982)			
17	*See* IPF-82-8	DE84751324	MN -20g	9:29933
CONF-8206240-	(Brookhaven symposium biology 32, Upton, NY, USA, 1-4 Jun 1982)			
6	*See* BNL-34673	DE84012217	MN -48	9:28928
7	*See* BNL-34681	DE84012174	MN -48	9:29317
CONF-820861-	(31. annual Denver X-ray conference, Denver, CO, USA, 3-5 Aug 1982)			
	Adv. X-Ray Anal., 26: 457-466(1982)			9:27792
	Adv. X-Ray Anal., 26: 385-390(1982)			9:28897
CONF-8208147-	(SLAC summer school on high-energy particle accelerators, Stanford, CA, USA, 2-13 Aug 1982)			
5	*See* SLAC-PUB-3221	DE84007911	MN -28	9:29065
CONF-8208173-	(CERN school of computing, Zinal, Switzerland, 29 Aug-11 Sep 1982)			
	See CERN-83-03	DE84780234	MN -34	9:30072
CONF-8208177-	(4. topical conference of the American Physical Society on high temperature plasma diagnostics, Boston, MA, USA)			
1	*See* IPF-82-15	DE84751332	MN -20	9:29937
CONF-820950-	(Conference on the neutron and its applications, Cambridge, UK, 13-17 Sep 1982)			
	Inst. Phys., Conf. Ser., 463-468(1983)			9:28000
CONF-8209212-	(DOE contractors' conference on indirect liquefaction, Pittsburgh, PA, USA, 8-9 Sep 1982)			
	NTIS, PC A16/MF A01; 1 (GPO Dep.)	DE84005786	MN -90d	9:28013

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CONF-8211151-	(Seminar on fast breeder fuel element development, Karlsruhe, F.R. Germany, 15-16 Nov 1982)			
	See KFK-3505	DE84751327	MN -79	9:28304
CONF-830169-	(Seminar on fast breeder physics and nuclear core design, Karlsruhe, F.R. Germany, 18-19 Jan 1983)			
	See KFK-3543	DE84751330	MN -79	9:28335
CONF-830201-	(Society of Automotive Engineers congress, Detroit, MI, USA, 28 Feb-4 Mar 1983)			
4	NTIS, PC A02; 3 (GPO Dep.)	DE84011706	MN -96	9:28711
CONF-830260-	(US/Japan symposium on compact toroids, Princeton, NJ, USA, 20-23 Feb 1983)			
1	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE84010610	MN -20	9:29920
CONF-830314-	(2. national conference on high power microwave technology, Adelphi, MD, USA, 1-3 Mar 1983)			
7	*See* UCRL-88711	DE84002788	MN -34A	9:29549
CONF-830354-	(International workshop on atomic physics for ion driven fusion, Paris, France, 21-25 Mar 1983)			
	J. Phys. (Paris), Colloq., 149-158(Nov 1983)			9:30034
	J. Phys. (Paris), Colloq., 39-66(Nov 1983)			9:30035
1	*See* SAND-83-1519	DE84005880	MN -21	9:30022
2	*See* MPQ-73	DE84751296	MN -20f	9:29874
CONF-8303119-	(Meeting on non destructive testing, Paris, France, 23-24 Mar 1983)			
1	*See* CEA-CONF-6834	DE84750659	MN -25	9:29023
CONF-8303120-	(Meeting on new cladding materials., Moscow, USSR, 9-19 Mar 1983)			
1	*See* CEA-CONF-6827	DE84750672	MN -25	9:28725
CONF-8303121-	(Microscopy of semiconducting materials meeting, Oxford, UK, 21-23 Mar 1983)			
1	*See* CEA-CONF-7006	DE84750673	MN -25	9:28731
CONF-8303122-	(Congress on dislocation structure and properties in semiconductors, Aussois, France, 7-11 Mar 1983)			
1	*See* CEA-CONF-7005	DE84750674	MN -25	9:28827
CONF-8303140-	(47. physicists meeting and spring meeting of DPG on atomic physics, mass spectrometry, molecular physics, high-speed phisics, Regensburg, F.R. Germany, 14-18 Mar 1983)			
1	*See* IPF-83-2	DE84751341	MN -20	9:29940
CONF-8304147-	(13. meeting on actinides, Elat, Israel, 26-29 Apr 1983)			
2	*See* CEA-CONF-6964	DE84750649	MN -04	9:28967
3	*See* CEA-CONF-6965	DE84750660	MN -04	9:27935
CONF-8304151-	(Scanning electron microscopy conference, Dearborn, MI, USA, 17 Apr-22 Oct 1983)			
1	*See* CEA-CONF-6924	DE84750647	MN -38	9:28729
CONF-8304153-	(11. international winter meeting on fundamental physics, Toledo, Spain, 11-16 Apr 1983)			
1	*See* CEA-CONF-6767	DE84750625	MN -34D	9:29584
CONF-830508-	(163. Electrochemical Society meeting, San Francisco, CA, USA, 8-13 May 1983)			
29	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE84011687	MN -63b	9:28068
CONF-830523-	(International conference on radioactive waste management, Seattle, WA, USA, 16-20 May 1983)			
21	*See* PNL-SA-11142	DE84010777	MN -70	9:27983
CONF-830538-	(6. international conference on radiation shielding, Tokyo, Japan, 16-20 May 1983)			
27	*See* CEA-CONF-6814	DE84750677	MN -85	9:28982
CONF-830545-	(Core systems working group information meeting, Richland, WA, USA, 10-12 May 1983)			
2	NTIS, PC A02/MF A01 (GPO Dep.)	DE84011743	MN -79b	9:28396
CONF-8305152-	(5. international congress on non-destructive control methods, Bordeaux, France, 30 May-3 Jun 1983)			
8	*See* CEA-CONF-6836	DE84750644	MN -38	9:29025
9	*See* CEA-CONF-6837	DE84750656	MN -38	9:29026
10	*See* CEA-CONF-6835	DE84750657	MN -38	9:29024
11	*See* CEA-CONF-6838	DE84750658	MN -38	9:29027
12	*See* CEA-CONF-7017	DE84750675	MN -38	9:29029
CONF-8305157-	(16. colloquium of numerical analysis, Guidel, France, 24-27 May 1983)			
2-Summ.	*See* CEA-CONF-6816	DE84750608	MN -34C	9:29868
CONF-8305187-	(23. Cracow school of theoretical physics, Zakopane, Poland, 30 May-11 Jun 1983)			
2	*See* SLAC-PUB-3263	DE84009136	MN -34D	9:29674
CONF-8305191-	(3. international meeting of test stations for SWECS, Pellworm, F.R. Germany, 3-4 May 1983)			
1	*See* GKSS-83/E/61	DE84751475	MN -60	9:29187
CONF-830607-	(American Society of Mechanical Engineers pressure vessel and piping conference, Portland, OR, USA, 19-24 Jun 1983)			
31	*See* CEA-CONF-6856	DE84750646	MN -80	9:28345
CONF-830665-	(Health Physics Society summmer school on internal radiation dosimetry, Catonsville, MD, USA, 12-17 Jun 1983)			
6	NTIS, PC A03/MF A01 (GPO Dep.)	DE84010522	MN -41	9:29431
CONF-830675-	(6. high energy heavy ion study and 2. workshop on anomalons, Berkeley, CA, USA, 28 Jun-1 Jul 1983)			
	See LBL-16281	DE84005862	STD -34C	9:29691

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CONF-830680-	(International symposium on the structure and properties of crystal defects, Liblice, Czechoslovakia, 13-17 Jun 1983)			
3	*See* CEA-CONF-6846	DE84750641	MN -25	9:28726
CONF-8306139-	(Time projection chamber workshop, Vancouver, Canada, 23-25 Jun 1983)			
2	*See* CEA-CONF-6867	DE84750628	MN -34D	9:29119
CONF-8306156-	(Workshop on experimentation at HERA, Amsterdam, Netherlands, 9-11 Jun 1983)			
	See DESY-HERA-83/20	DE84751338	MN -28	9:29585
CONF-8306170-	(Congress on plutonium and radioprotection, Saclay, France, 14-16 Jun 1983)			
1	*See* CEA-CONF-6860	DE84750643	MN -11	9:29269
CONF-8306193-	(4. IASTED international symposium on modelling and simulation, Lugano, Switzerland, 21-24 Jun 1983)			
1	*See* GKSS-83/E/64	DE84751505	MN -11	9:29297
CONF-8306196-	(Chemical Systems Laboratories conference on obscuration and aerosol research, Aberdeen Proving Ground, MD, USA, 20-24 Jun 1983)			
1	NTIS, PC A02; 3 (GPO Dep.)	DE84003202	MN -4	9:29201
CONF-830714-	(20. IEEE annual conference on nuclear and space radiation effects, Gatlinburg, TN, USA, 18-21 Jul 1983)			
14	*See* CEA-CONF-6850	DE84750630	MN -34C	9:29869
CONF-830719-	(American Physical Society meeting on shock waves in condensed media, Santa Fe, NM, USA, 18-21 Jul 1983)			
59	*See* CEA-CONF-6876	DE84750621	MN -25	9:28727
60	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE84003573	MN -25	9:28733
CONF-830755-	(1. international symposium on acoustic emmision from composites, San Francisco, CA, USA, 19-21 Jul 1983)			
2	*See* UCRL-88273	DE84011064	MN -38	9:29031
CONF-830782-	(11. L. H. Gray conference on cellular repair of radiation damage - mechanisms and modifying agents, Glasgow, UK, 18-22 Jul 1983)			
4	*See* LBL-16379	DE84012247	MN -48	9:29435
CONF-8307115-	(4. European conference on internal friction and ultrasonic attenuation in solids, Villeurbanne, France, 5-7 Jul 1983)			
1	*See* CEA-CONF-7013	DE84750676	MN -25	9:28732
CONF-830805-	(7. international conference on structural mechanics in reactor technology, Chicago, IL, USA, 22-26 Aug 1983)			
77	*See* CEA-CONF-6978	DE84750616	MN -80	9:28347
78	*See* CEA-CONF-6977	DE84750617	MN -78	9:28357
79	*See* CEA-CONF-6982	DE84750631	MN -80	9:28825
80	*See* CEA-CONF-6908	DE84750633	MN -78	9:28274
81	*See* CEA-CONF-6976	DE84750636	MN -80	9:28346
82	*See* CEA-CONF-6985	DE84750637	MN -80	9:28350
83	*See* CEA-CONF-6983	DE84750638	MN -80	9:28826
84	*See* CEA-CONF-6975	DE84750639	MN -79	9:28295
85	*See* CEA-CONF-6907	DE84750642	MN -80	9:29028
86	*See* CEA-CONF-6980	DE84750667	MN -80	9:28348
87	*See* CEA-CONF-6981	DE84750668	MN -80	9:28349
88	*See* CEA-CONF-6984	DE84750669	MN -80	9:28395
89	*See* CEA-CONF-6979	DE84750670	MN -80	9:28824
95	*See* HEDL-SA-2998-FP	DE84010321	MN -80	9:27901
96	*See* HEDL-SA-2578-FP	DE84010322	MN -80	9:28419
CONF-830833-	(International conference on nuclear physics, Florence, Italy, 29 Aug-3 Sep 1983)			
19-Summ.	*See* CEA-CONF-6911	DE84750620	MN -34C	9:29788
20	*See* CEA-CONF-6910	DE84750623	MN -34C	9:29804
21	*See* CEA-CONF-6972	DE84750627	MN -34C	9:29805
CONF-830839-	(Solar world congress, Perth, Australia, 15-19 Aug 1983)			
3	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE84011837	MN -4	9:28953
CONF-830962-	(10. international conference on few-body problems in physics, Karlsruhe, F.R. Germany, 21-27 Aug 1983)			
12-Summ.	*See* CEA-CONF-6893	DE84750618	MN -34C	9:29697
13-Summ.	*See* CEA-CONF-6896	DE84750619	MN -34C	9:29698
14	*See* CEA-CONF-6897	DE84750624	MN -34C	9:29699
CONF-830888-	(5. international conference on liquid and amorphous metals, Los Angeles, CA, USA, 15-19 Aug 1983)			
13	*See* CEA-CONF-6892	DE84750622	MN -25	9:28728
CONF-8308130-	(Symposium on refractory alloy technology for space nuclear power applications, Oak Ridge, TN, USA, 10-11 Aug 1983)			
	NTIS, PC A13/MF A01; 1	DE84001745	STD -25	9:28320
CONF-8308153-	(7. international conference on mathemitical physics, Boulder, CO, USA, 1-11 Aug 1983)			
2	*See* DESY-83-109	DE84751335	MN -34D	9:29624
CONF-8308157-	(18. assembly of the International Union of Geodesy and Geophysics, Hamburg, F.R. Germany, 15 Aug-27 Sep 1983)			
1-Summ.	*See* CEA-CONF-6903	DE84750650	MN -11	9:29520
2-Summ.	*See* CEA-CONF-6898	DE84750651	MN -11	9:29515
3-Summ.	*See* CEA-CONF-6900	DE84750652	MN -11	9:29517
4-Summ.	*See* CEA-CONF-6901	DE84750653	MN -11	9:29518
5-Summ.	*See* CEA-CONF-6902	DE84750654	MN -11	9:29519
6-Summ.	*See* CEA-CONF-6899	DE84750655	MN -11	9:29516
CONF-830942-	(3. topical meeting on fusion reactor materials, Albuquerque, NM, USA, 19-23 Sep 1983)			
48	NTIS, PC A02/MF A01 (GPO Dep.)	DE84001300	MN -20c	9:28734

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CONF-830969-	(12. international conference on solid state nuclear track detectors, Acapulco, Mexico, 4-10 Sep 1983)			
11	*See* CEA-CONF-6939	DE84750609	MN -37	9:29122
12	*See* CEA-CONF-6937	DE84750610	MN -37	9:29120
13	*See* CEA-CONF-6938	DE84750611	MN -37	9:29121
CONF-830972-	(20. congress of the International Association of Hydraulic Research, Moscow, USSR, 5-9 Sep 1983)			
2	*See* CEA-CONF-6920	DE84750634	MN -38	9:29010
3	*See* CEA-CONF-6921	DE84750635	MN -38	9:29011
CONF-8309103-	(9. international vacuum congress and 5. international conference on solid surfaces, Madrid, Spain, 26 Sep-1 Oct 1983)			
11	*See* CEA-CONF-6923	DE84750612	MN -21	9:29986
CONF-8309124-	(1. international conference on the chemistry and technology of the lanthanides and actinides, Venice, Italy, 5-10 Sep 1983)			
4	*See* CEA-CONF-6955	DE84750640	MN -25	9:28730
5	*See* CEA-CONF-6922	DE84750645	MN -04	9:28966
6	*See* CEA-CONF-6954	DE84750648	MN -04	9:28858
CONF-8309144-	(EPS conference on computing in accelerator design and operation, Berlin, F.R. Germany, 20-23 Sep 1983)			
9	*See* CEA-CONF-6973	DE84750613	MN -28	9:29067
CONF-8309163-	(Conference on low energy tests of conservation laws in particle physics, Blacksburg, VA, USA, 12-14 Sep 1983)			
5	*See* BNL-34599	DE84010786	MN -34D	9:29656
CONF-8309186-	(49. meeting of the French working group on dosimetry, Grenoble, France, 21-22 Sep 1983)			
2	*See* CEA-CONF-6823	DE84750632	MN -78	9:28273
CONF-8309203-	(13. European solid state device research conference and 8. symposium on solid state device technology (ESSDERC 83), Canterbury, UK, 13-16 Sep 1983)			
1	*See* CEA-CONF-6956	DE84750614	MN -37	9:29147
2	*See* CEA-CONF-6957	DE84750615	MN -37	9:29148
CONF-8309204-	(INS symposium on high energy photonuclear reactions and related topics, Tokyo, Japan, 29 Sep-1 Oct 1983)			
1	*See* CEA-CONF-6974	DE84750626	MN -34D	9:29806
CONF-8309216-	(Meeting on interactions between charged particle beams and matter, Grenoble, France, 1 Sep 1983)			
1	*See* RL-83-083	DE84701677	MN -20	9:30015
CONF-831011-	(American Vacuum Society symposium, Boston, MA, USA, 31 Oct-4 Nov 1983)			
7	*See* BNL-34652	DE84011563	MN -28	9:29091
CONF-831012-	(International symposium on use and development of low and medium flux research reactors, Cambridge, MA, USA, 17-19 Oct 1983)			
11	*See* CEA-CONF-7019	DE84750665	MN -80	9:28387
12	*See* CEA-CONF-6971	DE84750666	MN -80	9:28386
CONF-831015-	(Nuclear science symposium, San Francisco, CA, USA, 19-21 Oct 1983)			
	IEEE Trans. Nucl. Sci., 31: No. 1, 738-792(Feb 1984)			9:28368
	IEEE Trans. Nucl. Sci., 31: No. 1, 876-878(Feb 1984)			9:28369
	IEEE Trans. Nucl. Sci., 31: No. 1, 853-857(Feb 1984)			9:28370
	IEEE Trans. Nucl. Sci., 31: No. 1, 862-867(Feb 1984)			9:28371
	IEEE Trans. Nucl. Sci., 31: No. 1, 868-875(Feb 1984)			9:28372
	IEEE Trans. Nucl. Sci., 31: No. 1, 749-753(Feb 1984)			9:28373
	IEEE Trans. Nucl. Sci., 31: No. 1, 754-756(Feb 1984)			9:28374
	IEEE Trans. Nucl. Sci., 31: No. 1, 743-748(Feb 1984)			9:28375
	IEEE Trans. Nucl. Sci., 31: No. 1, 733-737(Feb 1984)			9:28376
	IEEE Trans. Nucl. Sci., 31: No. 1, 721-725(Feb 1984)			9:28377
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	IEEE Trans. Nucl. Sci., 31: No. 1, 701-705(Feb 1984)			9:28380
	IEEE Trans. Nucl. Sci., 31: No. 1, 243-248(Feb 1984)			9:29140
	IEEE Trans. Nucl. Sci., 31: No. 1, 180-183(Feb 1984)			9:29141
	IEEE Trans. Nucl. Sci., 31: No. 1, 249-252(Feb 1984)			9:29142
	IEEE Trans. Nucl. Sci., 31: No. 1, 581-584(Feb 1984)			9:29396
48	*See* UCRL-89915	DE84002457	MN -34	9:30089
CONF-831028-	(Photovoltaic solar energy conference, Athens, Greece, 17-22 Oct 1983)			
5	NTIS, PC A02/MF A01 (GPO Dep.)	DE84011688	MN -63b	9:28069
CONF-831047-	(American Nuclear Society winter meeting, San Francisco, CA, USA, 30 Oct-4 Nov 1983)			
	Trans. Am. Nucl. Soc., 45: 172(Oct 1983)			9:29974
	Trans. Am. Nucl. Soc., 45: 183-184(Oct 1983)			9:30036
	Trans. Am. Nucl. Soc., 45: 184-185(Oct 1983)			9:30037
	Trans. Am. Nucl. Soc., 45: 177-179(Oct 1983)			9:30038
	Trans. Am. Nucl. Soc., 45: 176-177(Oct 1983)			9:30039
	Trans. Am. Nucl. Soc., 45: 175-176(Oct 1983)			9:30040
	Trans. Am. Nucl. Soc., 45: 173-175(Oct 1983)			9:30041
	Trans. Am. Nucl. Soc., 45: 181-182(Oct 1983)			9:30042
	Trans. Am. Nucl. Soc., 45: 180-181(Oct 1983)			9:30043
	Trans. Am. Nucl. Soc., 45: 225-226(Oct 1983)			9:30044
CONF-8310163-	(18. international thermal conductivity conference, Rapid City, SD, USA, 3-5 Oct 1983)			
11	*See* UCRL-90725	DE84011312	MN -11	9:28840

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CONF-8310175-	(36. annual Pacific Coast Regional meeting of the American Ceramic Society, San Diego, CA, USA, 3-5 Oct 1983)			
4	*See* IS-M-464	DE84012838	MN -25	9:28805
CONF-8310179-	(8. international symposium on polynuclear aromatic hydrocarbons, Columbus, OH, USA, 26-28 Oct 1983)			
9	*See* PNL-SA-11745	DE84011875	MN -90a	9:27791
CONF-8310251-	(US-Western Europe regional seminar on metal complex catalysts and metal catalyzed reactions in intracrystalline environments, Brugge, Belgium, 24-26 Oct 1983)			
2	NTIS, PC A02/MF A01 (GPO Dep.)	DE84011701	MN -4	9:28899
CONF-831106-	(Topical meeting on safeguards technology - the process safeguards interface, Hilton Head Island, SC, USA, 28 Nov-1 Dec 1983)			
26	*See* PNL-SA-11835	DE84011882	MN -15	9:27997
CONF-831174-	(Materials Research Society annual meeting, Boston, MA, USA, 14-17 Nov 1983)			
86	*See* PNL-SA-11796	DE84010899	MN -70	9:27975
87	*See* RHO-BW-SA-314-P	DE84011715	MN -70	9:28792
CONF-8311100-	(12. international conference on global environmental problems, Chicago, IL, USA, 24-27 Nov 1983)			
1-Rev.1	*See* UCRL-89964-Rev.1	DE84010986	MN -11	9:29225
CONF-8311124-	(7. international symposium on the scientific basis for nuclear waste management, Boston, MA, USA, 14-17 Nov 1983)			
2	*See* PNL-SA-11783	DE84011900	MN -70	9:27974
3	*See* PNL-SA-11713	DE84008948	MN -70	9:27950
CONF-8311146-	(Symposium on optical materials for high power lasers, Boulder, CO, USA, 14-16 Nov 1983)			
4	*See* UCRL-89872	DE84011560	MN -38	9:28839
CONF-8311154-	(3. European symposium on semiconductor detectors, Munich, F.R. Germany, 14-16 Nov 1983)			
1	*See* BNL-34524	DE84010290	MN -37	9:29118
CONF-831203-	(10. symposium on fusion engineering, Philadelphia, PA, USA, 5-9 Dec 1983)			
139	*See* SAI/APPAT-23-30-31-33-34	DE84011201	STD -20g	9:30021
CONF-831265-	(6. international conference on lasers and applications, San Francisco, CA, USA, 12-16 Dec 1983)			
3	*See* LBL-16405	DE84010717	MN -4	9:28874
CONF-831267-	(Workshop on supersymmetry in physics, Los Alamos, NM, USA, 15-20 Dec 1983)			
4	*See* LA-UR-84-1311	DE84011329	MN -34D	9:29673
CONF-840141-	(INMM seminar on spent fuel storage, Washington, DC, USA, 10-13 Jan 1984)			
4	*See* PNL-SA-11894	DE84011250	MN -85	9:27921
CONF-840142-	(International symposium on heavy ion accelerators and their applications to inertial fusion, Tokyo, Japan, 23-27 Jan 1984)			
11-Rev.1	*See* UCRL-90246-Rev.1	DE84011048	MN -21	9:30029
CONF-840155-	(ANS energy contest, Richland, WA, USA, 24 Jan 1984)			
1	*See* PNL-SA-11898	DE84010680	MN -59a	9:28127
CONF-840201-	(ASME energy sources technology conference and exhibition, New Orleans, LA, USA, 12-16 Feb 1984)			
11	*See* SERI/TP-252-2107	DE84000097	STD -62e	9:28471
CONF-840202-	(17. midyear topical meeting of the Health Physics Society, Pasco, WA, USA, 5-9 Feb 1984)			
25	*See* PNL-SA-11565	DE84011901	MN -41	9:30082
CONF-840256-	(Chapman conference on collisionless shock waves in the heliosphere, Napa Valley, CA, USA, 20-24 Feb 1984)			
2	*See* LA-UR-84-1391	DE84011353	MN -34B	9:29548
3	*See* LA-UR-84-1199	DE84011352	MN -34B	9:29547
CONF-840269-	(NAPAP Task Group G peer review meeting, Burlington, VT, USA, 14-17 Feb 1984)			
8	*See* PNL-SA-11980	DE84011268	MN -11	9:28510
9	*See* PNL-SA-11907	DE84011897	MN -11	9:29224
CONF-840275-	(Workshop on anti pp options for the SSC, Chicago, IL, USA, 13-17 Feb 1984)			
2	*See* SLAC-PUB-3310	DE84010566	MN -34D	9:29609
6	*See* ANL-HEP-CP-84-16	DE84012102	MN -28	9:29112
CONF-840281-	(23. Internationale Universitatswochen fur Kernphysik, Schladming, Austria, 20 Feb-1 Mar 1984)			
1	*See* BNL-34642	DE84010892	MN -34D	9:29657
CONF-840284-	(3. international winterschool on new developments in solid state physics, Salzubrg, Austria, 26 Feb-2 Mar 1984)			
1-Rev.1	*See* UCRL-89743-Rev.1	DE84008894	MN -34	9:29882
CONF-840285-	(Committee on international cooperation in magnetic fusion of the National Research Council, Livermore, CA, USA, 7 Feb 1984)			
1	*See* UCRL-90338	DE84010989	MN -20	9:30030
CONF-840286-	(Workshop on large plant control systems, Oak Ridge, TN, USA, 14-15 Feb 1984)			
1	NTIS, PC A02/MF A01 (GPO Dep.)	DE84011735	MN -80	9:28360
CONF-840288-	(Symposium on better ceramics through chemistry, Albuquerque, NM, USA, 27-29 Feb 1984)			
2	*See* SAND-83-1948C	DE84011256	MN -4	9:28836
CONF-840302-	(11. annual energy technology conference and exposition, Washington, DC, USA, 19-21 Mar 1984)			
4	*See* PNL-SA-12081	DE84011686	MN -60	9:28243

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CONF-840307-	(Waste management '84, Tucson, AZ, USA, 11-15 Mar 1984)			
28	*See* SAND-83-2121C	DE84010598	MN -70	9:27954
31	*See* PNL-SA-12086	DE84010704	MN -85	9:27953
33	*See* PNL-SA-11940	DE84011361	MN -70B	9:27952
34	*See* PNL-SA-11714	DE84011872	MN -70	9:27951
35	*See* EGG-M-19683	DE84011751	MN -70	9:27941
37	*See* EGG-M-19383	DE84011748	MN -70B	9:27940
39	*See* EGG-M-19883	DE84011750	MN -70	9:27942
40	*See* EGG-M-19983	DE84011746	MN -70	9:27943
41	*See* TVA/OP/FUE-84/5	DE84901144	MN -70	9:27923
42	*See* PNL-SA-12116	DE84011870	MN -70	9:28791
CONF-840311-	(4. international symposium on heating in toroidal plasmas, Rome, Italy, 21-28 Mar 1984)			
6	*See* GA-A-17494	DE84010936	MN -20a	9:29929
8	*See* DOE/ET/51013-115	DE84010314	STD -20g	9:29922
10	*See* DOE/ET/51013-119	DE84010576	STD -20g	9:29923
11	*See* DOE/ET/51013-121	DE84010586	STD -20a	9:29924
12	*See* UCRL-90096	DE84010555	MN -20a	9:29957
CONF-840374-	(APCA specialty meeting on environmental impact of natural emissions, Research Triangle Park, NC, USA, 7-9 Mar 1984)			
3	NTIS, PC A02/MF A01 (GPO Dep.)	DE84011698	MN -11	9:29198
CONF-840379-	(4. course on fundamental interactions in low energy systems, Erice, Italy, 31 Mar-6 Apr 1984)			
1	*See* LA-UR-84-1327	DE84011410	MN -34D	9:29606
CONF-840396-	(International conference on instrumentation for colliding beam physics, Novosibirsk, USSR, 15-21 Mar 1984)			
4	*See* SLAC-PUB-3317	DE84010882	MN -28	9:29136
5	*See* SLAC-PUB-3339	DE84012273	MN -34A	9:29151
CONF-8403100-	(Conference of Z-pinches for fusion, Alexandria, VA, USA, 29-30 Mar 1984)			
5	*See* LA-UR-84-1249	DE84011369	MN -20f	9:29954
CONF-8403101-	(3. winter workshop on nuclear dynamics, Copper Mountain, CO, USA, 5-9 Mar 1984)			
7	NTIS, PC A02/MF A01 (GPO Dep.)	DE84011651	MN -34C	9:29746
CONF-8403112-	(International symposium on nuclear spectroscopy and nuclear interactions, Osaka, Japan, 21-24 Mar 1984)			
1	*See* BNL-34569	DE84010793	MN -34D	9:29583
5	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE84011709	MN -34C	9:29715
CONF-8403117-	(Meeting of the Nuclear Energy Agency Nuclear Data Commission, Jaeri, Japan, 12-16 Mar 1984)			
1	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE84010525	MN -34C	9:29763
CONF-8403121-	(New particle production at high energy meeting: The Recontre de Moriond, La Plagne, France, 4-10 Mar 1984)			
1	*See* SLAC-PUB-3321	DE84011859	MN -34D	9:29610
2	*See* SLAC-PUB-3325	DE84011858	MN -34D	9:29611
CONF-8403122-	(4. general CMD conference of the condensed matter division of the European Physical Society, Hague, Netherlands, 19-22 Mar 1984)			
1	*See* BNL-34691	DE84011910	MN -34C	9:28724
CONF-840403-	(4. international symposium on gaseous dielectrics, Knoxville, TN, USA, 29 Apr-3 May 1984)			
1	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE84011444	MN -38	9:29043
3	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE84011656	MN -34A	9:29552
4	NTIS, PC A02/MF A01 (GPO Dep.)	DE84011670	MN -41	9:28828
5	NTIS, PC A02/MF A01 (GPO Dep.)	DE84011668	MN -34A	9:29553
CONF-840407-	(International symposium on the biosphere, Miami Beach, FL, USA, 16-18 Apr 1984)			
1	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE84011628	MN -11	9:29234
CONF-840408-	(5. international conference on nuclear methods in environmental and energy research, Mayaguez, Puerto Rico, 2-6 Apr 1984)			
1-Rev.	*See* PNL-SA-11699-Rev.	DE84011862	MN -4	9:28881
8	*See* BNL-34613	DE84010933	MN -4	9:28857
9	*See* PNL-SA-11719	DE84010775	MN -37	9:29135
11	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE84011643	MN -11	9:29270
12	NTIS, PC A02/MF A01 (GPO Dep.)	DE84011466	MN -90l	9:27782
13	*See* PNL-SA-12093	DE84011896	MN -11	9:29303
14	*See* PNL-SA-11679	DE84011877	MN -11	9:29245
CONF-840410-	(1. European Communities conference on solar heating, Amsterdam, Netherlands, 30 Apr-4 May 1984)			
1	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE84009626	MN -59a	9:28188
CONF-840411-	(3. meeting on liquid metal in energy applications, Oxford, UK, 9-13 Apr 1984)			
20	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE84011635	MN -25	9:28735
CONF-840412-	(American power conference, Chicago, IL, USA, 24-26 Apr 1984)			
6	*See* HEDL-SA-3131-FP	DE84011474	MN -79b	9:28303
7	*See* TVA/OP/FUE-84/6	DE84901083	MN -78	9:28272
CONF-840413-	(Topical meeting on robotics and remote handling in hostile environments, Gatlinburg, TN, USA, 23-26 Apr 1984)			
3	NTIS, PC A03/MF A01; 1 (GPO Dep.)	DE84011460	MN -86	9:27902
4	NTIS, PC A03/MF A01; 1 (GPO Dep.)	DE84011455	MN -86	9:27903
5	NTIS, PC A02; 3 (GPO Dep.)	DE84011646	MN -86	9:27904
7	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE84011459	MN -86	9:27905
8	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE84011465	MN -86	9:27906

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9	NTIS, PC A02/MF A01 (GPO Dep.)	DE84011464	MN -38	9:28983
10	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE84011634	MN -86	9:27907
11	NTIS, PC A02/MF A01 (GPO Dep.)	DE84011633	MN -86	9:27908
12	NTIS, PC A03/MF A01 (GPO Dep.)	DE84011578	MN -86	9:27909
CONF-840415-	(187. national meeting of the American Chemical Society, St. Louis, MO, USA, 8-13 Apr 1984)			
21	NTIS, PC A03/MF A01; 1 (GPO Dep.)	DE84011660	MN -11	9:29199
22	NTIS, PC A03/MF A01 (GPO Dep.)	DE84011630	MN -11	9:29200
23	*See* IS-M-477	DE84012839	MN -90a	9:27772
CONF-840418-	(30. annual technical meeting on environmental integration technology today for a quality tomorrow, Orlando, FL, USA, 30 Apr-3 May 1984)			
1	NTIS, PC A02/MF A01 (GPO Dep.)	DE84011462	MN -11	9:28506
CONF-840434-	(6. annual industrial energy conservation technology conference, Houston, TX, USA, 15-18 Apr 1984)			
1	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE84009585	MN -95f	9:28670
CONF-840441-	(17. photovoltaic specialist conference, Orlando, FL, USA, 30 Apr-4 May 1984)			
1	*See* SAND-84-0968C	DE84010977	MN -63	9:28080
CONF-840448-	(65. annual American Welding Society convention, Dallas, TX, USA, 9-13 Apr 1984)			
4	*See* DP-MS-83-123	DE84011507	MN -25	9:2*767
CONF-840449-	(2. symposium on resonance ionization spectroscopy and its applications, Knoxville, TN, USA, 16-20 Apr 1984)			
3	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE84011664	MN -34A	9:29554
4	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE84011661	MN -34A	9:29555
5	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE84011662	MN -34A	9:29556
6	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE84011663	MN -38	9:28999
7	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE84011654	MN -34A	9:29557
8	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE84011655	MN -34A	9:29558
9	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE84011638	MN -34A	9:29559
10	NTIS, PC A02/MF A01 (GPO Dep.)	DE84011650	MN -4	9:28859
CONF-840456-	(6. annual symposium on industrial coal utilization, Pittsburgh, PA, USA, 9-10 Apr 1984)			
1	NTIS, PC A03/MF A01; 1 (GPO Dep.)	DE84011461	MN -90	9:28250
CONF-840458-	(Seminar on how to manage data and information as a resource, Washington, DC, USA, 9-10 Apr 1984)			
1	*See* UCRL-90392	DE84007412	MN -32	9:30090
CONF-840489-	(Gas-liquid chemistry of natural waters conference, Upton, NY, USA, 1-6 Apr 1984)			
2	*See* BNL-34692	DE84011918	MN -11	9:29186
3	*See* BNL-34741	DE84011844	MN -11	9:29196
4	*See* BNL-34735	DE84011911	MN -11	9:29194
CONF-840493-	(Energy from biomass technical review meeting, Portland, OR, USA, 23-25 Apr 1984)			
1	*See* PNL-SA-12026	DE84011879	MN -61D	9:28036
CONF-8404104-	(Spring meeting of the Combustion Institute, Boulder, CO, USA, 2-3 Apr 1984)			
3	*See* UCRL-90835	DE84012265	MN -38	9:29019
CONF-8404110-	(4. international conference on high temperature science - HYTHERM, Santa Fe, NM, USA, 2-6 Apr 1984)			
3	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE84010504	MN -4	9:28900
5	NTIS, PC A02/MF A01 (GPO Dep.)	DE84011629	MN -4	9:28802
CONF-8404116-	(21. space congress, Cape Kennedy, FL, USA, 24-26 Apr 1984)			
2	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE84011631	MN -86	9:27910
CONF-8404119-	(Workshop on gauge theory on lattice, Argonne, IL, USA, 5-7 Apr 1984)			
1	*See* BNL-34641	DE84010880	MN -34	9:30071
CONF-8404121-	(17. oil shale symposium, Golden, CO, USA, 16-18 Apr 1984)			
2	*See* LBL-17019	DE84010801	MN -91	9:27893
5	*See* UCRL-90156	DE84010554	MN -91	9:27887
CONF-8404124-	(SPIE technical symposium, Arlington, VA, USA, 29 Apr-4 May 1984)			
4	*See* UCRL-90033	DE84010992	MN -21	9:30027
5	*See* SAND-84-1029C	DE84012281	MN -37	9:29048
CONF-8404127-	(INMM packaging and transportation seminar, Washington, DC, USA, 17-19 Apr 1984)			
2	*See* SAND-84-0826C	DE84010302	MN -71	9:27922
CONF-8404130-	(International Atomic Energy Consultants meeting on format for the exchange of evaluated neutron nuclear data, Vienna, Austria, 1-4 Apr 1984)			
1	*See* LA-UR-84-1026	DE84009983	MN -34C	9:29690
CONF-8404132-	(IEEE international magnetic conference, Hamburg, F.R. Germany, 30 Apr 1984)			
1	*See* UNI-SA-122	DE84009699	MN -80	9:28355
CONF-8404135-	(International conference on metallurgical coatings, San Diego, CA, USA, 9 Apr 1908)			
2	*See* PNL-SA-11881	DE84011902	MN -25	9:28807
3	*See* EGG-M-21683	DE84012542	MN -25	9:28819
CONF-8404137-	(American Society for Metals conference on materials for fusion energy systems, Washington, DC, USA, 29 Apr-2 May 1984)			
1	NTIS, PC A03/MF A01; 1 (GPO Dep.)	DE84010521	MN -20c	9:29987

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CONF-8404138-	(8. national engineering symposium of the Mexican American Engineering Society, Albuquerque, NM, USA, 11-13 Apr 1984)			
1	*See* UCRL-90191	DE84011047	MN -20	9:30028
CONF-8404139-	(Solar central receiver annual meeting, San Diego, CA, USA, 24-26 Apr 1984)			
1	*See* SERI/TP-252-2334	DE84004504	MN -62	9:28131
CONF-8404140-	(Small hydropower workshop, Columbia, MO, USA, 10 Apr 1984)			
1	*See* EGG-M-09184	DE84011180	MN -97e	9:28059
2	*See* EGG-M-09284	DE84011452	MN -97e	9:28053
3	*See* EGG-M-09384	DE84011614	MN -97e	9:28060
CONF-8404141-	(International topical conference on kinetics of aggregation and gelation, Atlanta, GA, USA, 2-4 Apr 1984)			
1	*See* LA-UR-84-1245	DE84011370	MN -48	9:29408
2	NTIS, PC A02; 3 (GPO Dep.)	DE84011445	MN -34	9:28984
3	NTIS, PC A02/MF A01 (GPO Dep.)	DE84011665	MN -34	9:28743
4	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE84011669	MN -25	9:28744
CONF-8404142-	(Lead Industries/Zinc Institute joint meeting, Denver, CO, USA, 3 Apr 1984)			
1	*See* SAND-84-0684C	DE84011193	MN -94cb	9:28484
CONF-8404143-	(10. international conference on cyclotrons and their applications, East Lansing, MI, USA, 30 Apr-3 May 1984)			
2	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE84012104	MN -28	9:28001
3	NTIS, PC A02/MF A01 (GPO Dep.)	DE84011637	MN -28	9:29560
4	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE84011741	MN -28	9:29059
CONF-8404144-	(Modeling and simulation conference, Pittsburgh, PA, USA, 19-20 Apr 1984)			
1	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE84011657	MN -11	9:29252
CONF-8404145-	(Energy and environment symposium on facility siting and routing, Banff, Alberta, Canada, 15-18 Apr 1984)			
1	NTIS, PC A02/MF A01 (GPO Dep.)	DE84011641	MN -11	9:28508
2	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE84011644	MN -70B	9:27936
CONF-8404147-	(ASTM symposium on measured air leakage performance of buildings, Philadelphia, PA, USA, 2-3 Apr 1984)			
1	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE84011577	MN -41	9:28571
CONF-8404149-	(International symposium on environmental pollution and man, Cape Town, South Africa, 30 Apr-4 May 1984)			
1	*See* BNL-34757	DE84011846	MN -41	9:29430
CONF-8404152-	(25. Association for Energy Systems, Operations and Programming conference, Seattle, WA, USA, 30 Apr-4 May 1984)			
1	NTIS, PC A02/MF A01 (GPO Dep.)	DE84012092	MN -32	9:30073
CONF-8404154-	(Workshop on prospects for research with radioactive beams from heavy-ion accelerators, Washington, DC, USA, 26-27 Apr 1984)			
1	*See* UCRL-90708	DE84012266	MN -28	9:29066
CONF-840509-	(6. symposium on biotechnology for fuels and chemicals, Gatlinburg, TN, USA, 1 May 1984)			
1	*See* PNL-SA-11891	DE84011898	MN -61D	9:28035
CONF-840520-	(6. international conference on plasma surface interactions in controlled fusion devices, Nagoya, Japan, 14-18 May 1984)			
1	*See* GA-A-17520	DE84011178	MN -20a	9:29930
CONF-840529-	(Linear accelerator conference, Darmstadt-Seeheim, F.R. Germany, 7-11 May 1984)			
15	*See* LA-UR-84-1359	DE84011412	MN -28	9:29063
16	*See* LA-UR-84-1375	DE84011415	MN -28	9:29064
17	*See* LA-UR-84-1343	DE84011385	MN -28	9:29073
18	*See* LA-UR-84-1278	DE84011367	MN -28	9:29100
19	*See* LA-UR-84-1277	DE84011368	MN -28	9:29070
20	*See* LA-UR-84-1307	DE84011341	MN -34A	9:29072
22	*See* LA-UR-84-1306	DE84011375	MN -28	9:29062
23	*See* LA-UR-84-1281	DE84011408	MN -28	9:29071
25	*See* BNL-34706	DE84011915	MN -28	9:29057
29	*See* SLAC-PUB-3284	DE84012415	MN -28	9:29090
30	*See* SLAC-PUB-3285	DE84012072	MN -28	9:29108
31	*See* SLAC-PUB-3324	DE84012074	MN -28	9:29109
32	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE84011740	MN -28	9:29058
33	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE84011729	MN -28	9:29093
34	NTIS, PC A02; 3 (GPO Dep.)	DE84011733	MN -28	9:29094
35	*See* BNL-34705	DE84011912	MN -28	9:29092
CONF-840531-	(6. annual symposium on safeguards and nuclear material management, Venice, Italy, 14-18 May 1984)			
2	*See* SAND-84-1049C	DE84011486	MN -15	9:27999
3	*See* LA-UR-84-1390	DE84011346	MN -15	9:27994
7	*See* LA-UR-84-1517	DE84012632	MN -15	9:27995
CONF-840561-	(17. IEEE photovoltaic specialists conference, Kissimmee, FL, USA, 1-4 May 1984)			
4	*See* SAND-83-2032C	DE84010973	MN -63c	9:28078
10	*See* SAND-84-0992C	DE84011484	MN -63	9:28097
11	*See* SAND-84-1000C	DE84011255	MN -63	9:28081
12	*See* SAND-83-2028C	DE84010846	MN -63a	9:28077
CONF-840565-	(32. annual North American Bethological Society meeting, Raleigh, NC, USA, 23-25 May 1984)			
2	*See* DP-MS-83-127	DE84011517	MN -11	9:29304

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CONF-840570-	(Materials for future energy systems conference, Washington, DC, USA, 1-3 May 1984)			
1	*See* LA-UR-84-1354	DE84011409	MN -20c	9:30010
2	*See* SAND-84-0111C	DE84011288	MN -63	9:28079
3	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE84012094	MN -64	9:28099
4	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE84011739	MN -90h	9:27716
6	*See* LA-UR-84-1428	DE84012662	MN -59a	9:28163
CONF-840572-	(International symposium on observation of the continental crust through drilling, Tarrytown, NY, USA, 20-25 May 1984)			
1	*See* SAND-83-2413C	DE84012241	MN -66	9:28223
CONF-840577-	(30. international instrumentation symposium, Denver, CO, USA, 7-10 May 1984)			
6	*See* DOE/NV/10282-4066	DE84011543	MN -37	9:29152
CONF-8405120-	(SPE/DOE/GRI unconventional gas recovery symposium, Pittsburgh, PA, USA, 13-15 May 1984)			
8	*See* HEDL-SA-3061-FP	DE84011473	MN -78	9:27920
CONF-8405131-	(6. annual ideas in science and engineering exposition and symposium, Albuquerque, NM, USA, 2 May 1984)			
5	*See* LA-UR-84-1324	DE84011342	MN -32	9:30080
CONF-8405138-	(4. DOE heat engines contractors' meeting, Morgantown, WV, USA, 1-3 May 1984)			
1	NTIS, PC A02/MF A01 (GPO Dep.)	DE84012103	MN -90f	9:29055
CONF-8405146-	(8. annual larval fish conference, Vancouver, Canada, 6-10 May 1984)			
1	*See* DP-MS-83-120	DE84011140	MN -11	9:29306
CONF-8405149-	(SOLERAS workshop on solar buildings, Riyadh, Saudi Arabia, 5-8 May 1984)			
1	*See* LA-UR-83-1294	DE84011328	MN -59b	9:28161
CONF-8405151-	(Computer aided engineering symposium, Wilmington, DE, USA, 15-17 May 1984)			
1	*See* DP-MS-84-39	DE84011519	MN -38	9:28985
2	*See* DP-MS-84-40	DE84011518	MN -38	9:30074
CONF-8405154-	(American Institute of Chemical Engineers spring national meeting, Anaheim, CA, USA, 20-23 May 1984)			
1	NTIS, PC A03/MF A01; 1 (GPO Dep.)	DE84011499	MN -90a	9:27717
2	NTIS, PC A03/MF A01 (GPO Dep.)	DE84011378	MN -90b	9:27718
CONF-8405155-	(Inner space/outer space conference, Batavia, IL, USA, 2-5 May 1984)			
2	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE84011737	MN -34B	9:29532
CONF-8405157-	(16. biomass thermochemical conversion contractors meeting, Portland, OR, USA, 8-9 May 1984)			
1	*See* PNL-SA-12260	DE84011880	MN -61D	9:28037
CONF-8405158-	(SPIE technical symposium, Arlington, VA, USA, 1-2 May 1984)			
1	*See* PNL-SA-12218	DE84011504	MN -25	9:29004
CONF-840604-	(12. international symposium on effects of radiation on materials, Williamsburg, VA, USA, 18-20 Jun 1984)			
4	*See* HEDL-SA-3024-A	DE84010320	MN -20c	9:28771
CONF-840608-	(7. international symposium on the electric road vehicle, Versailles, France, 26-29 Jun 1984)			
1	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE84011703	MN -96	9:28712
CONF-840612-	(Air Pollution Control Association annual meeting, San Francisco, CA, USA, 25-28 Jun 1984)			
7	*See* BNL-34740	DE84011845	MN -11	9:29195
8	NTIS, PC A02/MF A01 (GPO Dep.)	DE84011708	MN -11	9:28507
9-Rev.1	*See* BNL-34565-Rev.1	DE84011848	MN -11	9:29192
10-Rev.1	*See* BNL-34566-Rev.1	DE84011847	MN -11	9:29193
11	*See* TVA/PUB-84/34	DE84901038	MN -90i	9:27801
CONF-840614-	(Annual meeting of the American Nuclear Society, New Orleans, LA, USA, 3-8 Jun 1984)			
2	NTIS, PC A02/MF A01	DE84004004	MN -79	9:28296
4	NTIS, PC A02/MF A01 (GPO Dep.)	DE84005430	MN -79p	9:28397
5	NTIS, PC A02/MF A01 (GPO Dep.)	DE84005209	MN -80	9:28398
7	NTIS, PC A02/MF A01 (GPO Dep.)	DE84005428	MN -79p	9:28361
9	*See* SAND-84-0097C	DE84005526	MN -80	9:28455
17	NTIS, PC A02/MF A01 (GPO Dep.)	DE84006470	MN -78	9:28399
21	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE84006406	MN -79k	9:28400
25	NTIS, PC A02/MF A01 (GPO Dep.)	DE84006423	MN -79b	9:28297
27	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE84006550	MN -80	9:28401
29	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE84006326	MN -79p	9:28402
40	*See* HEDL-SA-2918-FP	DE84007168	MN -79	9:28301
44	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE84005538	MN -80	9:28362
46	*See* HEDL-SA-3092-S	DE84010317	MN -79g	9:28388
52	NTIS, PC A03/MF A01; 1 (GPO Dep.)	DE84012100	MN -79	9:28298
CONF-840616-	(International conference on plasma physics, Lausanne, Switzerland, 27 Jun-3 Jul 1984)			
14	*See* DOE/DP/40124-22	DE84009625	MN -21	9:29988
15	*See* LA-UR-84-1154	DE84011336	MN -21	9:30009
CONF-840622-	(Annual meeting of the American Solar Energy Society, Anaheim, CA, USA, 5-9 Jun 1984)			
2	*See* SAND-84-0874C	DE84010597	MN -63	9:28096
3	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE84010475	MN -59	9:28180
4	*See* SAND-84-0125C	DE84010974	MN -63	9:28095
5	*See* LA-UR-84-1338	DE84011344	MN -59	9:28162

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6	See SERI/TP-253-2288	DE84004495	STD -62c	9:28171
7	See SERI/TP-253-2309	DE84004499	STD -59c	9:28174
8	See SERI/TP-253-2324	DE84004501	STD -59b	9:28176
9	See SERI/TP-253-2310	DE84004498	STD -59c	9:28175
10	See SERI/TP-253-2299	DE84004496	STD -59c	9:28173
11	See SERI/TP-253-2298	DE84004497	STD -59c	9:28172
CONF-840627-	(29. annual meeting of the Health Physics Society, New Orleans, LA, USA, 3-7 Jun 1984)			
2	See LA-UR-84-1726	DE84012578	MN -41	9:29172
CONF-840633-	(25. US symposium on rock mechanics, Evanston, IL, USA, 25-27 Jun 1984)			
11	See LBL-17520	DE84010783	MN -11	9:28835
13	See SAND-83-2287C	DE84009927	MN -70	9:27955
CONF-840647-	(ASME pressure vessel and piping conference, San Antonio, TX, USA, 17-21 Jun 1984)			
2	See LA-UR-83-3514	DE84004333	MN -79h	9:28319
4	See HEDL-SA-2959	DE84006546	MN -79	9:28302
5	NTIS, PC A03/MF A01 (GPO Dep.)	DE84006442	MN -79k	9:28299
9	NTIS, PC A04/MF A01; 1 (GPO Dep.)	DE84009185	MN -80	9:28351
10	NTIS, PC A02/MF A01 (GPO Dep.)	DE84009148	MN -79k	9:28403
14	See UCRL-89724	DE84011068	MN -38	9:29018
16	See BNL-NUREG-34542	DE84010886	MN -38	9:28981
CONF-840650-	(9. international conference on numerical methods in fluid dynamics, Saclay, France, 25-29 Jun 1984)			
1	See LA-UR-83-3549	DE84004320	MN -32	9:30079
CONF-840662-	(31. NASA/US Army power sources symposium, Atlantic City, NJ, USA, 11-14 Jun 1984)			
1	See SAND-84-0520C	DE84011680	MN -94c	9:28483
CONF-840667-	(22. symposium on engineering aspects of MHD, State College, MS, USA, 26-28 Jun 1984)			
3	NTIS, PC A03/MF A01; 1 (GPO Dep.)	DE84012099	MN -90g	9:28561
CONF-8406111-	(International Energy Agency workshop on the design and performance of large solar thermal collectors, San Diego, CA, USA, 11-13 Jun 1984)			
1	See SAND-84-0506C	DE84010268	MN -62	9:28129
CONF-8406113-	(5. IMACS international symposium, Bethlehem, PA, USA, 19-21 Jun 1984)			
2	See BNL-34552	DE84010294	MN -34	9:29887
CONF-8406115-	(17. AIAA fluid dynamics, plasmadynamics and laser conference, Snowmass, CO, USA, 25-27 Jun 1984)			
1	See UCRL-90711	DE84011069	MN -21	9:30031
CONF-8406118-	(7. international conference of women engineers and scientists, Washington, DC, USA, 17-24 Jun 1984)			
1	See HEDL-SA-3128-FP	DE84011476	MN -32	9:30077
CONF-840701-	(Topical meeting on fission product behavior and source term research, Snowbird, UT, USA, 15-19 Jul 1984)			
3	See LBL-16893	DE84004633	MN -4	9:28358
10	NTIS, PC A02/MF A01 (GPO Dep.)	DE84009149	MN -78	9:28404
CONF-840702-	(5. world hydrogen energy conference, Toronto, Canada, 15-19 Jul 1984)			
3	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE84007279	MN -4	9:28543
4	See BNL-34233	DE84007389	MN -94d	9:28009
5	See BNL-34204	DE84010225	MN -94d	9:28008
6	See BNL-34391	DE84010226	MN -94d	9:28010
CONF-840706-	(Power Engineering Society summer meeting, Seattle, WA, USA, 15-20 Jul 1984)			
2	See DOE/NASA/20320-57	DE84006794	STD -60	9:28240
CONF-840710-	(National computer conference, Las Vegas, NV, USA, 1 Jul 1984)			
2	See LA-UR-83-3084	DE84001725	MN -32	9:30078
CONF-840711-	(American Electroplaters' Society SUR/FIN '84 conference, New York, NY, USA, 1 Jul 1984)			
2	See K/PS-5033	DE84006434	MN -4	9:28786
CONF-840712-	(21. IEEE annual conference on nuclear and space radiation effects, Colorado Springs, CO, USA, 22-25 Jul 1984)			
1	See EGG-10282-2033	DE84006669	MN -41	9:29124
2	See SAND-84-0525C	DE84008034	MN -38	9:29149
CONF-840720-	(International conference on numerical methods for transient and coupled problems, Venice, Italy, 9-13 Jul 1984)			
2	See UCRL-90239	DE84011551	MN -34	9:27780
CONF-840725-	(3. international conference on infrared physics, Zurich, Switzerland, 23-27 Jul 1984)			
2	See LBL-17390	DE84009237	MN -34	9:28875
4-Summ.	See LBL-17294-Summ.	DE84009246	MN -34A	9:29570
CONF-840743-	(8. IEEE international conference on conduction and breakdown in dielectric liquids, Pavia, Italy, 24-27 Jul 1984)			
1	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE84011700	MN -4	9:28954
CONF-840744-	(American Society of Civil Engineers Irrigation and Drainage Div. specialty conference, Flagstaff, AZ, USA, 24-26 Jul 1984)			
1	See LA-UR-84-1399	DE84011365	MN -11	9:29253
CONF-840801-	(20. international symposium on combustion, Ann Arbor, MI, USA, 12-17 Aug 1984)			
12	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE84011702	MN -4	9:28962
13	See LBL-17666	DE84012055	MN -4	9:28973

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CONF-840804-	(Intersociety energy conversion engineering conference, San Francisco, CA, USA, 19-24 Aug 1984)			
3	*See* DOE/NASA-1005-2	DE84010761	STD -96	9:28710
15	*See* SAND-84-0632C	DE84012239	MN -62	9:28187
CONF-840809-	(Geothermal Resources Council annual meeting, Reno, NV, USA, 27-29 Aug 1984)			
7	*See* LA-UR-84-1192	DE84011349	MN -66b	9:28228
8	*See* LA-UR-84-1208	DE84011372	MN -66b	9:28214
9	*See* LA-UR-84-1181	DE84011337	MN -66b	9:28198
10	*See* LA-UR-84-1186	DE84011373	MN -66a	9:28227
11	*See* LA-UR-84-1182	DE84011338	MN -66b	9:28226
12	*See* LA-UR-84-1194	DE84011351	MN -66b	9:28229
CONF-840901-	(ANS topical meeting on physics and shielding, Chicago, IL, USA, 17-19 Sep 1984)			
6	NTIS, PC A02/MF A01 (GPO Dep.)	DE84011707	MN -80	9:28300
COO-				
2218-302	*See* CONF-830260-1	DE84010610	MN -20	9:29920
2271-107	*See* DOE/ER/02271-107	DE84011854	MN -34D	9:29627
3166-34	*See* DOE/ER/03166-34	DE84011454	MN -25	9:28763
CTOM-				
49178	Canadian Theses on Microfiche Service, National Library of Canada, Ottawa, Canada K1A 0N4		ND -25	9:28745
50802	National Library of Canada, Canadian Theses on Microfiche Service, Ottawa, Canada K1A 0N4		ND -80	9:29012
CW-WR-				
69-078.F	*See* AD-865480/8			9:28698
DDAD-EDR-				
6144	*See* AD-515005/7			9:28697
DESY-				
83-109	NTIS (US Sales Only), PC A02/MF A01	DE84751335	MN -34D	9:29624
83-118	NTIS (US Sales Only), PC A05/MF A01	DE84751348	MN -34D	9:29625
DESY-HERA-				
83/ 20	NTIS (US Sales Only), PC A24/MF A01	DE84751338	MN -28	9:29585
DESY-L-Trans-				
286	Deutsches Elektronen-Synchrotron (DESY), Hamburg (Germany, F.R.)			9:29113
287	Deutsches Elektronen-Synchrotron (DESY), Hamburg (Germany, F.R.)			9:29587
DFVLR-FB-				
83-21	NTIS (US Sales Only), PC A07/MF A01; 1	DE84751223	MN -38	9:29000
DOE/BC-				
84/ 1/ SP	NTIS, PC A03/MF A01; 1 (GPO Dep.)	DE84011794	MN -92a	9:27846
DOE/BC/10361-				
39	NTIS, PC A05/MF A01 (GPO Dep.)	DE84012083	STD -92a	9:27847
DOE/BC/10450-				
1	NTIS, PC A06/MF A01 (GPO Dep.)	DE84011592	STD -92b	9:27850
DOE/BC/99996-				
2	NTIS, PC A04/MF A01; 1 (GPO Dep.)	DE84011235	STD -92a	9:27865
DOE/BP-				
149	NTIS, PC A04/MF A01; 1 (GPO Dep.)	DE84010331	MN -59	9:28142
211	NTIS, PC A06/MF A01; 1 (GPO Dep.)	DE84011832	MN -60	9:28234
212	NTIS, PC A05/MF A01; 1 (GPO Dep.)	DE84011835	MN -60	9:28235
254	NTIS, PC A04; 3 (GPO Dep.)	DE84012034	MN -11	9:29312
259	NTIS, PC A03/MF A01 (GPO Dep.)	DE84012152	MN -11	9:28509
DOE/CA/10024-				
T1	NTIS, PC A17/MF A01; 1 (GPO Dep.)	DE84001204	MN -59a	9:28063
T2	NTIS MF A01; 2 (GPO Dep.)	DE84000250	MN -59a	9:28064
DOE/CE-				
0069	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE84011566	MN -59b	9:28100
0070	NTIS, PC A02/MF A01 (GPO Dep.)	DE84010657	MN -62a	9:28143
DOE/CE/15095-				
8	NTIS, PC A03/MF A01 (GPO Dep.)	DE84007097	STD -59b	9:28144
T1	NTIS MF A01; 2 (GPO Dep.)	DE84010957	MN -95a	9:28558
DOE/CE/25082-				
T1	Life Support Systems, 4634 State St., Erie, PA 16509	TI84011489	ND -48	9:29380
DOE/CE/30719-				
T2	NTIS, PC A07/MF A01; 1 (GPO Dep.)	DE84012052	MN -64	9:28134
DOE/CE/50036-				
T2	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE84011177	MN -96	9:28720
DOE/CH/00016-				
1494	NTIS, PC A04/MF A01; 1	DE84000223	STD -90c	9:27719
DOE/CH/00178-				
T20-Vol.1	NTIS, PC A99/MF A01; 1 (GPO Dep.)	DE84011386	MN -62	9:28101
T20-Vol.2	NTIS, PC A18/MF A01; 1 (GPO Dep.)	DE84009363	MN -62	9:28102
DOE/CH/03000-				
T13	NTIS, PC A08/MF A01; 1 (GPO Dep.)	DE84012567	MN -2	9:29095
DOE/CH/10122-				
23	NTIS, PC A07; 3 (GPO Dep.)	DE84008544	MN -59c	9:28145
DOE/CS/10097-				
1	NTIS, PC A06/MF A01; 1 (GPO Dep.)	DE84012225	MN -95d	9:28572
DOE/CS/15059-				
T1	NTIS, PC A04/MF A01; 1 (GPO Dep.)	DE84012411	STD -95	9:28026
DOE/CS/20074-				
T1	NTIS, PC A07/MF A01; 1 (GPO Dep.)	DE84010364	MN -95d	9:28694

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DOE/CS/20448-				
T2	NTIS, PC A03; 3 (GPO Dep.)	DE84010739	MN -95d	9:28500
DOE/CS/22014-				
T1	NTIS, PC A04/MF A01; 1 (GPO Dep.)	DE84011207	MN -95d	9:28573
DOE/CS/23936-				
T5	NTIS, PC A04/MF A01 (GPO Dep.)	DE84010944	MN -95f	9:28574
T6	NTIS, PC A06/MF A01 (GPO Dep.)	DE84010945	MN -95f	9:28575
T7	NTIS, PC A05/MF A01 (GPO Dep.)	DE84010940	MN -95f	9:28576
T8	NTIS, PC A05/MF A01 (GPO Dep.)	DE84010941	MN -95f	9:28577
T9	NTIS, PC A03/MF A01 (GPO Dep.)	DE84012125	MN -95f	9:28578
DOE/CS/30156-				
T2	NTIS MF A01; 2 (GPO Dep.)	DE84010864	MN -59a	9:28146
DOE/CS/30379-				
T1	NTIS, PC A06/MF A01; 1 (GPO Dep.)	DE84009851	MN -59c	9:28147
DOE/CS/30569-				
30	NTIS, PC A07/MF A01; 1 (GPO Dep.)	DE84010813	STD -59a	9:28148
DOE/CS/32129-				
T1	NTIS, PC A07; 3 (GPO Dep.)	DE84009203	MN -59a	9:28149
T2	USDOE-TIC, PO Bx 62, Oak Ridge, TN 37830; 3	TI84009416	ND -59c	9:28150
DOE/CS/32197-				
3	NTIS, PC A04/MF A01; 1 (GPO Dep.)	DE84007878	STD -59b	9:28151
DOE/CS/34034-				
T1	NTIS, PC A03/MF A01 (GPO Dep.)	DE84010418	MN -59	9:28152
DOE/CS/40104-				
T2	NTIS, PC A08/MF A01; 1 (GPO Dep.)	DE84011692	MN -95f	9:28688
DOE/CS/40330-				
T1	NTIS, PC A10/MF A01 (GPO Dep.)	DE84007608	STD -95e	9:28672
DOE/CS/51101-				
4	American Institute of Aeronautics and Astronautics, 1290 Avenue of the Americas, New York, NY 10019	TI84010531	ND -62	9:28103
DOE/CS/69104-				
2	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE84008915	MN -58a	9:28559
4	NTIS, PC A03/MF A01; 1 (GPO Dep.)	DE84010426	MN -60	9:28233
5	NTIS, PC A02/MF A01 (GPO Dep.)	DE84009682	MN -59c	9:28153
DOE/CS/84005-				
T1	NTIS, PC A02/MF A01 (GPO Dep.)	DE84011782	MN -48	9:29318
T2	NTIS, PC A02/MF A01 (GPO Dep.)	DE84011472	MN -48	9:29319
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0001/ 13	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE84011792	STD -16	9:27985
DOE/DP/00539-				
050	NTIS, PC A04/MF A01; 1 (GPO Dep.)	DE84011323	MN -11	9:29271
DOE/DP/01118-				
T1	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE84012227	MN -34A	9:29561
DOE/DP/30215-				
T1	NTIS, PC A08/MF A01 (GPO Dep.)	DE84012284	MN -15	9:27986
T2	NTIS, PC A07/MF A01 (GPO Dep.)	DE84012283	MN -15	9:27987
DOE/DP/40124-				
22	NTIS, PC A02/MF A01 (GPO Dep.)	DE84009625	MN -21	9:29988
24	NTIS, PC A04/MF A01 (GPO Dep.)	DE84011146	MN -21	9:29989
25	NTIS, PC A04/MF A01 (GPO Dep.)	DE84011142	MN -21	9:29990
26	NTIS, PC A04/MF A01 (GPO Dep.)	DE84011143	MN -21	9:29991
27	NTIS, PC A04/MF A01 (GPO Dep.)	DE84011145	MN -21	9:29992
28	NTIS, PC A04/MF A01 (GPO Dep.)	DE84011147	MN -21	9:29993
DOE/DP/40152-				
T5	NTIS, PC A02/MF A01 (GPO Dep.)	DE84010507	MN -21	9:29921
DOE/DR/00789-				
T1	NTIS, PC A04/MF A01; 1 (GPO Dep.)	DE84012477	MN -62	9:28104
T2	NTIS, PC A04/MF A01; 1 (GPO Dep.)	DE84012479	MN -62	9:28105
T3	NTIS MF A01; 2 (GPO Dep.)	DE84012478	MN -62	9:28106
DOE/EI/06409-				
T2	NTIS, PC A08/MF A01; 1 (GPO Dep.)	DE84012405	MN -98	9:28492
DOE/EI/10562-				
T1-Vol.1	NTIS, PC A05/MF A01; 1 (GPO Dep.)	DE84005026	MN -98	9:28493
T1-Vol.2	NTIS, PC A10; 3 (GPO Dep.)	DE84005336	MN -98	9:28494
T1-Vol.3	NTIS, PC A08; 3 (GPO Dep.)	DE84003394	MN -98	9:28495
T1-Vol.4	NTIS, PC A03/MF A01; 1 (GPO Dep.)	DE84005358	MN -98	9:28496
DOE/EIA-				
0035(84/ 02)	NTIS, PC A06/MF A01; 1 - GPO (GPO Dep.)	DE84012531	MN -98	9:27853
0109(84/ 03)	NTIS, PC A05/MF A01; 1 - GPO (GPO Dep.)	DE84011807	MN -98B	9:27854
0204(84/ 02)	NTIS, PC A03/MF A01; 1 - GPO (GPO Dep.)	DE84011809	MN -98	9:28488
0214(82)	NTIS, PC A99/MF A01 - GPO (GPO Dep.)	DE84011599	MN -98G	9:27855
0214(82) S	NTIS, PC A05/MF A01; 1 - GPO (GPO Dep.)	DE84011869	MN -98	9:28556
0380(84/ 03)	NTIS, PC A06/MF A01; 1 - GPO (GPO Dep.)	DE84012484	MN -98B	9:27856
0397(83/ 4Q)	NTIS, PC A15/MF A01; 1 - GPO (GPO Dep.)	DE84011537	MN -98E	9:28545
0444(EX)	NTIS, PC A03/MF A01; 1 - GPO (GPO Dep.)	DE84012065	MN -98A	9:27841
0445(82)	NTIS, PC A02/MF A01; 1 - GPO (GPO Dep.)	DE84011567	MN -98C	9:27876
0446	NTIS, PC A06/MF A01; 1 - GPO (GPO Dep.)	DE84012579	MN -98	9:27988
DOE/EIS-				
0093-F	NTIS, PC A13/MF A01; 1 (GPO Dep.)	DE84011247	MN -98E	9:29315
DOE/ER-				
0046/ 15	NTIS, PC A07/MF A01; 1 (GPO Dep.)	DE84009143	STD -20c	9:28746
0046/ 16	NTIS, PC A05/MF A01; 1 (GPO Dep.)	DE84011791	STD -20c	9:29996
0165/ 1	NTIS, PC A05/MF A01 (GPO Dep.)	DE84010967	MN -13	9:30056
DOE/ER/01198-				
1409	NTIS, PC A09/MF A01; 1 (GPO Dep.)	DE84012395	MN -25	9:28762

Report No.	Availability	Order No.	Distribution Category	Abstract No.
DOE/ER/01428-504	NTIS, PC A06/MF A01; 1 (GPO Dep.)	DE84011609	MN -34D	9:29588
DOE/ER/02271-107	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE84011854	MN -34D	9:29627
DOE/ER/03166-34	NTIS, PC A03/MF A01; 1 (GPO Dep.)	DE84011454	MN -25	9:28763
DOE/ER/03992-552	NTIS, PC A05/MF A01 (GPO Dep.)	DE84011502	MN -34D	9:29628
DOE/ER/04341-6	NTIS, PC A02/MF A01 (GPO Dep.)	DE84012461	MN -4	9:28901
DOE/ER/04463-7	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE84012474	MN -4	9:28027
DOE/ER/05111-T1	NTIS, PC A02/MF A01 (GPO Dep.)	DE84011506	MN -34	9:28803
DOE/ER/10125-T1	NTIS, PC A04/MF A01 (GPO Dep.)	DE84012401	MN -98F	9:28515
DOE/ER/10170-T1	NTIS, PC A06/MF A01; 1 (GPO Dep.)	DE84011262	MN -62	9:28092
DOE/ER/10265-1	NTIS, PC A02/MF A01 (GPO Dep.)	DE84011594	MN -61E	9:28044
2	NTIS, PC A03/MF A01; 1 (GPO Dep.)	DE84011579	MN -61E	9:28045
DOE/ER/10369-T2	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE84011453	MN -94cc	9:28070
DOE/ER/10414-T2	NTIS, PC A02/MF A01 (GPO Dep.)	DE84011892	MN -4	9:28902
DOE/ER/10667-5	NTIS, PC A06/MF A01; 1 (GPO Dep.)	DE84011503	MN -34D	9:29589
DOE/ER/10678-4	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE84012171	MN -48	9:29320
DOE/ER/10711-3	NTIS, PC A02/MF A01 (GPO Dep.)	DE84011498	MN -32	9:29911
DOE/ER/10745-2	NTIS, PC A03/MF A01; 1 (GPO Dep.)	DE84011836	MN -4	9:28955
DOE/ER/10819-T1	NTIS, PC A02/MF A01	DE83008111	MN -4	9:28972
DOE/ER/10910-03	NTIS, PC A02/MF A01 (GPO Dep.)	DE84012752	MN -25	9:28764
DOE/ER/10911-6	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE84012475	MN -4	9:28956
DOE/ER/12003-5	NTIS, PC A03/MF A01; 1 (GPO Dep.)	DE84012399	MN -48	9:29321
DOE/ER/13124-1	NTIS, PC A06; 3 (GPO Dep.)	DE84011617	MN -11	9:29521
DOE/ER/13127-03	NTIS, PC A02/MF A01 (GPO Dep.)	DE84012466	MN -4	9:28860
DOE/ER/40089-1	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE84012050	MN -28	9:29114
DOE/ER/40103-T1	NTIS, PC A06/MF A01; 1 (GPO Dep.)	DE84010325	MN -34D	9:29590
DOE/ER/40108-1	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE84010422	MN -34D	9:29629
DOE/ER/40121-T1	NTIS, PC A05/MF A01; 1 (GPO Dep.)	DE84009878	MN -20b	9:29997
DOE/ER/45030-1	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE84011783	MN -25	9:28765
DOE/ER/60023-T1	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE84011895	MN -11	9:29202
DOE/ER/60084-3	NTIS, PC A03/MF A01 (GPO Dep.)	DE84012460	MN -48	9:29381
DOE/ER/60186-3	NTIS, PC A03/MF A01; 1 (GPO Dep.)	DE84010829	MN -41	9:29203
DOE/ET/00089-3	NTIS, PC A05/MF A01; 1 (GPO Dep.)	DE84006880	MN -62b	9:28181
DOE/ET/10069-T89	NTIS (US Sales Only), PC A09/MF A01; 1 (GPO Dep.)	DE84011495	MN -90d	9:27720
DOE/ET/10502-T1	NTIS, PC A04/MF A01; 1 (GPO Dep.)	DE84011261	MN -90b	9:27821
DOE/ET/10664-T1	NTIS, PC A02/MF A01 (GPO Dep.)	DE84012420	MN -90a	9:28028
T2	NTIS, PC A02/MF A01 (GPO Dep.)	DE84011787	MN -90a	9:28029
T3	NTIS, PC A02/MF A01 (GPO Dep.)	DE84012322	MN -90a	9:28030
DOE/ET/11434-T1	NTIS, PC A07/MF A01; 1 (GPO Dep.)	DE84012403	MN -96	9:28699
DOE/ET/12507-T1	NTIS, PC A06/MF A01; 1 (GPO Dep.)	DE84009376	STD -90	9:27808
DOE/ET/13800-6	NTIS, PC A06/MF A01; 1 (GPO Dep.)	DE84008292	STD -90d	9:27721
DOE/ET/14693-T12	NTIS, PC A02/MF A01 (GPO Dep.)	DE84007693	MN -98A	9:28541
DOE/ET/14800-T6	NTIS, PC A05/MF A01; 1 (GPO Dep.)	DE84012431	STD -90d	9:27722
DOE/ET/15322-T6	NTIS, PC A04/MF A01 (GPO Dep.)	DE84012386	MN -25	9:28766
DOE/ET/15440-17	NTIS, PC A03/MF A01 (GPO Dep.)	DE84007231	STD -93	9:28563

Report No.	Availability	Order No.	Distribution Category	Abstract No.
DOE/ET/15491-1565	NTIS, PC A24/MF A01; 1 (GPO Dep.)	DE84003097	STD -90f	9:28254
DOE/ET/17019-7	NTIS, PC A05/MF A01; 1 (GPO Dep.)	DE84011243	STD -93	9:28564
8	NTIS, PC A05/MF A01 (GPO Dep.)	DE84011244	STD -93	9:28565
10	NTIS, PC A07/MF A01; 1 (GPO Dep.)	DE84011241	STD -93	9:28566
11	NTIS, PC A06/MF A01; 1 (GPO Dep.)	DE84011240	STD -93	9:28567
DOE/ET/20312-5	NTIS, PC A02/MF A01 (GPO Dep.)	DE84009790	MN -64	9:28135
DOE/ET/20342-T11	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE84009326	MN -64	9:28136
T12	NTIS, PC A03/MF A01; 1 (GPO Dep.)	DE84011065	MN -33	9:28003
DOE/ET/20599-T1	NTIS, PC A03/MF A01; 1 (GPO Dep.)	DE84012458	MN -61A	9:28071
DOE/ET/21007-1	NTIS, PC A06/MF A01; 1 (GPO Dep.)	DE84011217	MN -62	9:28107
2	NTIS, PC A06/MF A01; 1 (GPO Dep.)	DE84011218	MN -62	9:28108
3	NTIS, PC A08/MF A01; 1 (GPO Dep.)	DE84011219	MN -62	9:28109
4	NTIS, PC A02/MF A01 (GPO Dep.)	DE84011220	MN -62	9:28110
DOE/ET/27014-T8	NTIS, PC A03/MF A01; 1 (GPO Dep.)	DE84012505	STD -66a	9:28192
T9	NTIS, PC A04/MF A01; 1 (GPO Dep.)	DE84012545	STD -66a	9:28193
T10	NTIS, PC A05/MF A01; 1 (GPO Dep.)	DE84012546	STD -66a	9:28200
T11	NTIS, PC A08/MF A01; 1 (GPO Dep.)	DE84012507	STD -66a	9:28201
T14	NTIS, PC A16/MF A01; 1 (GPO Dep.)	DE84012503	STD -66a	9:28202
T15	NTIS, PC A07/MF A01; 1 (GPO Dep.)	DE84012506	STD -66a	9:28203
T16	NTIS, PC A11/MF A01; 1 (GPO Dep.)	DE84012508	STD -66a	9:28204
DOE/ET/27055-10	NTIS, PC A07/MF A01; 1 (GPO Dep.)	DE84011266	STD -66a	9:28231
DOE/ET/27205-T1	NTIS, PC A15/MF A01; 1 (GPO Dep.)	DE84009679	STD -66a	9:28205
DOE/ET/28365-23	NTIS, PC A04/MF A01; 1 (GPO Dep.)	DE84012500	MN -66a	9:28206
DOE/ET/28407-4	NTIS, PC A16/MF A01; 1 (GPO Dep.)	DE84011598	STD -66a	9:28194
DOE/ET/29033-T1	NTIS, PC A08/MF A01; 1 (GPO Dep.)	DE84011275	MN -97c	9:28251
DOE/ET/34015-6	NTIS, PC A06/MF A01; 1 (GPO Dep.)	DE84006506	STD -78	9:28275
DOE/ET/34030-7	NTIS (US Sales Only), PC A05/MF A01; 1 (GPO Dep.)	DE84012138	STD -78	9:28405
DOE/ET/34202-86	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE84011195	MN -77	9:28290
DOE/ET/51013-115	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE84010314	STD -20g	9:29922
119	NTIS, PC A02/MF A01 (GPO Dep.)	DE84010576	STD -20g	9:29923
121	NTIS, PC A02/MF A01 (GPO Dep.)	DE84010586	STD -20a	9:29924
DOE/EV/01071-2	NTIS, PC A03/MF A01; 1 (GPO Dep.)	DE84010816	MN -48	9:29322
DOE/EV/02725-T2	NTIS, PC A03/MF A01 (GPO Dep.)	DE84011508	MN -48	9:29323
DOE/EV/04960-T1	NTIS, PC A99; 3 (GPO Dep.)	DE84012747	MN -91	9:27802
DOE/EV/10316-1-Pt.1	NTIS, PC A07/MF A01; 1 (GPO Dep.)	DE84010858	MN -11	9:28497
1-Pt.2	NTIS, PC A07; 3 (GPO Dep.)	DE84010857	MN -11	9:28498
DOE/EV/70022-13-1	NTIS, PC A06/MF A01; 1 (GPO Dep.)	DE84002119	MN -48	9:29412
DOE/FE/00016-T34	NTIS, PC A02/MF A01 (GPO Dep.)	DE84012749	MN -88	9:27812
DOE/FE/30005-T1	NTIS, PC A03/MF A01; 1 (GPO Dep.)	DE84008895	MN -91	9:27842
DOE/FE/55014-T8	NTIS, PC A08/MF A01; 1 (GPO Dep.)	DE84010286	STD -90c	9:27723
DOE/FE/60177-1571	NTIS, PC A06/MF A01; 1 (GPO Dep.)	DE84009293	STD -91	9:27883
1590	NTIS, PC AA13/MF A01; 1 (GPO Dep.)	DE84012285	STD -91	9:27884
DOE/FE/60181-1531	NTIS, PC A12/MF A01; 1 (GPO Dep.)	DE84011585	STD -90	9:27710
1574	NTIS, PC A13/MF A01; 1 (GPO Dep.)	DE84012133	STD -90	9:27724
DOE/FE/60339-3	NTIS, PC A05/MF A01; 1 (GPO Dep.)	DE84010970	STD -90e	9:27725
DOE/IA/06316-T1	NTIS, PC A07/MF A01; 1 (GPO Dep.)	DE84011693	MN -13	9:28560
DOE/ID-10119	NTIS, PC A07/MF A01 (GPO Dep.)	DE84012143	STD -78	9:28406
DOE/ID/12018-10	NTIS, PC A03/MF A01 (GPO Dep.)	DE84012499	MN -95d	9:28579
DOE/ID/12057-T7	NTIS, PC A05/MF A01; 1 (GPO Dep.)	DE84010827	MN -66a	9:28195
DOE/ID/12079-95	NTIS, PC A05/MF A01 (GPO Dep.)	DE84012192	MN -66a	9:28196
96	NTIS, PC A04/MF A01 (GPO Dep.)	DE84012185	MN -66a	9:28207
97	NTIS, PC A04/MF A01; 1 (GPO Dep.)	DE84012184	MN -66a	9:28208
104	NTIS, PC A02/MF A01 (GPO Dep.)	DE84012186	MN -66a	9:28209

Report No.	Availability	Order No.	Distribution Category	Abstract No.
107	NTIS, PC A02/MF A01 (GPO Dep.)	DE84012190	MN -66a	9:28210
DOE/JPL/956615-84/ 2	NTIS, PC A03/MF A01; 1 (GPO Dep.)	DE84011003	STD -63b	9:28072
DOE/LC/10332-1582	NTIS, PC A12/MF A01; 1 (GPO Dep.)	DE84009263	STD -91	9:27885
DOE/LC/10409-18	NTIS, PC A13; 3 (GPO Dep.)	DE84001922	MN -91	9:27891
DOE/LC/10870-1568	NTIS, PC A06/MF A01; 1 (GPO Dep.)	DE84009297	STD -91	9:27892
DOE/LC/10877-1567	NTIS, PC A02/MF A01 (GPO Dep.)	DE84009296	STD -91	9:27888
DOE/LC/10900-1572	NTIS, PC A08/MF A01; 1 (GPO Dep.)	DE84009288	STD -91	9:27889
DOE/MC/10513-T7	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE84011380	MN -92a	9:27813
DOE/MC/10643-T1	NTIS, PC A06/MF A01; 1 (GPO Dep.)	DE84012843	MN -92a	9:27809
DOE/MC/16026-1611	NTIS, PC A03/MF A01 (GPO Dep.)	DE84012147	STD -90d	9:27726
DOE/MC/19163-T22	NTIS, PC A24/MF A01; 1 (GPO Dep.)	DE84012846	MN -90c	9:27727
DOE/METC/SP-202	NTIS, PC A03/MF A01 (GPO Dep.)	DE84000221	STD -92	9:27814
DOE/NASA-0266-1	NTIS, PC A04/MF A01 (GPO Dep.)	DE84009884	STD -96	9:28700
0337-1	NTIS, PC A02/MF A01; 1	DE84012274	STD -60	9:28239
1005-2	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE84010761	STD -96	9:28710
DOE/NASA/20320-57	NTIS, PC A02/MF A01 (GPO Dep.)	DE84006794	STD -60	9:28240
DOE/NBM-4010757	NTIS MF A01; 2 (GPO Dep.)	DE84010757	MN -97c	9:28546
4011123	NTIS, PC A04/MF A01; 1 (GPO Dep.)	DE84011123	MN -92	9:27866
4011697	NTIS, PC A07/MF A01; 1 (GPO Dep.)	DE84011697	MN -20f	9:29925
4012204	NTIS, PC A05/MF A01 (GPO Dep.)	DE84012204	MN -97e	9:28055
4012797	NTIS, PC A05/MF A01; 1 (GPO Dep.)	DE84012797	MN -11	9:29204
4012850	NTIS, PC A03/MF A01; 1 (GPO Dep.)	DE84012850	MN -16	9:27989
84010611	NTIS, PC A13/FM A01; 1 (GPO Dep.)	DE84010611	MN -11	9:28511
DOE/NE-0048/ 5	NTIS, PC A06/MF A01; 1 (GPO Dep.)	DE84010683	STD -80	9:28521
DOE/NV/10032-1	NTIS, PC A02/MF A01 (GPO Dep.)	DE84011388	MN -96	9:28713
DOE/NV/10081-1	NTIS, PC A16/MF A01; 1 (GPO Dep.)	DE84010540	MN -66b	9:28211
DOE/NV/10282-4066	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE84011543	MN -37	9:29152
DOE/OR/00033-T62	NTIS, PC A06/MF A01 (GPO Dep.)	DE84012244	MN -32	9:30057
DOE/OR/03054-17	NTIS, PC A15/MF A01; 1 (GPO Dep.)	DE84010969	STD -89	9:27728
26	NTIS, PC A18/MF A01; 1 (GPO Dep.)	DE84010871	STD -89	9:27745
57	NTIS, PC A03/MF A01; 1 (GPO Dep.)	DE84011554	STD -89	9:27757
68-Vol.1	NTIS, PC A03/MF A01; 1 (GPO Dep.)	DE84012978	STD -89	9:27758
81	NTIS, PC A12/MF A01; 1 (GPO Dep.)	DE84012746	STD -89	9:27759
DOE/OR/21354-T2	NTIS, PC A05/MF A01; 1 (GPO Dep.)	DE84011601	MN -13	9:30058
DOE/OR/21400-T8	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE84011659	MN -25	9:30054
T9	NTIS, PC A06/MF A01; 1 (GPO Dep.)	DE84011214	MN -95d	9:28580
T11	NTIS, PC A02/MF A01 (GPO Dep.)	DE84011652	MN -48	9:29466
T15	NTIS, PC A05/MF A01; 1 (GPO Dep.)	DE84012524	MN -2	9:28407
T19	NTIS, PC A03/MF A01; 1 (GPO Dep.)	DE84011642	MN -98B	9:27857
DOE/PC/30223-13	NTIS, PC A11/MF A01; 1 (GPO Dep.)	DE84010698	STD -90a	9:27783
DOE/PC/30252-T12	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE84011624	MN -90a	9:27784
DOE/PC/40783-T14	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE84012029	STD -90a	9:27785
DOE/PC/40799-T10	NTIS, PC A03/MF A01 (GPO Dep.)	DE84011813	STD -90d	9:27760
DOE/PC/40807-T10	NTIS, PC A15/MF A01 (GPO Dep.)	DE84009968	STD -90a	9:27822
DOE/PC/50041-36	NTIS, PC A05/MF A01; 1 (GPO Dep.)	DE84012432	STD -90d	9:27761
DOE/PC/50266-6	NTIS, PC A02/MF A01 (GPO Dep.)	DE84011263	STD -90b	9:27826
DOE/PC/50793-T6	NTIS, PC A03/MF A01 (GPO Dep.)	DE84006602	STD -90d	9:27762
DOE/PC/50795-T1	NTIS, PC A03/MF A01; 1	DE84002415	STD -90d	9:27763
DOE/PC/50799-T3	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE84011894	MN -90d	9:27764
DOE/PC/53019-T1	NTIS, PC A02/MF A01 (GPO Dep.)	DE84004737	STD -90d	9:27765
DOE/PC/60047-T3	NTIS, PC A03/MF A01; 1 (GPO Dep.)	DE84010316	STD -90d	9:27766

Report No.	Availability	Order No.	Distribution Category	Abstract No.
DOE/PC/60261-				
2	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE84012121	MN -90i	9:27794
3	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE84012156	MN -90i	9:27795
5	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE84012157	MN -90i	9:27796
DOE/PC/60784-				
T1	NTIS, PC A03/MF A01; 1 (GPO Dep.)	DE84012528	STD -90d	9:27767
DOE/PC/60785-				
3	NTIS, PC A03/MF A01 (GPO Dep.)	DE84012743	STD -90a	9:27786
DOE/PC/60796-				
3	NTIS, PC A02/MF A01 (GPO Dep.)	DE84012383	MN -90a	9:27768
DOE/PC/60807-				
3	NTIS, PC A02/MF A01 (GPO Dep.)	DE84012124	STD -90a	9:27787
DOE/PC/61254-				
T1	NTIS, PC A03/MF A01; 1 (GPO Dep.)	DE84011153	STD -90i	9:29205
DOE/PE/06419-				
T4	NTIS, PC A04/MF A01 (GPO Dep.)	DE84006090	MN -95	9:28501
DOE/PETC/TR-				
84/ 7	NTIS, PC A03/MF A01; 1 (GPO Dep.)	DE84012132	STD -90b	9:27788
DOE/PN/00292-				
T4	NTIS, PC A06/MF A01; 1 (GPO Dep.)	DE84011600	MN -11	9:29235
DOE/PO/10850-				
3-Vol.1	NTIS, PC A99/MF A01; 1 (GPO Dep.)	DE84011571	STD -92	9:27867
3-Vol.2	NTIS, PC A99/MF A01; 1 (GPO Dep.)	DE84011572	STD -92	9:27868
3-Vol.3	NTIS, PC A03/MF A01 (GPO Dep.)	DE84011573	STD -92	9:27869
DOE/R1/10850-				
1	NTIS, PC A03/MF A01; 1 (GPO Dep.)	DE84011541	MN -13	9:28581
DOE/R5/10243-				
3	NTIS, PC A06; 3 (GPO Dep.)	DE84009742	MN -59b	9:28154
DOE/R6/12054-				
T1	NTIS, PC A03/MF A01; 1 (GPO Dep.)	DE84006385	STD -95d	9:28582
DOE/R7/01133-				
T1	NTIS, PC A02/MF A01 (GPO Dep.)	DE84007857	MN -61D	9:28182
DOE/R7/01157-				
T1	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE84007847	MN -61D	9:28046
DOE/R7/01161-				
T1	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE84010013	MN -59b	9:28155
DOE/R7/01168-				
T1	NTIS, PC A03/MF A01; 1 (GPO Dep.)	DE84010006	MN -61D	9:28673
DOE/R7/01170-				
T1	NTIS, PC A03/MF A01; 1 (GPO Dep.)	DE84010008	MN -59c	9:28183
DOE/R7/01173-				
T1	NTIS, PC A02; 3 (GPO Dep.)	DE84010088	MN -59b	9:28156
DOE/R7/01210-				
T1	NTIS, PC A03/MF A01; 1 (GPO Dep.)	DE84009764	MN -61D	9:28073
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T1	NTIS, PC A03; 3 (GPO Dep.)	DE84009763	MN -59c	9:28184
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T1	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE84009678	MN -62	9:28189
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T1	NTIS, PC A02; 3 (GPO Dep.)	DE84010448	MN -59a	9:28157
DOE/R7/01234-				
T1	NTIS, PC A02; 3 (GPO Dep.)	DE84010452	MN -59a	9:28185
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T1	NTIS, PC A03/MF A01; 1 (GPO Dep.)	DE84010451	MN -61D	9:28051
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T1	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE84010457	MN -59a	9:28158
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T1	NTIS, PC A08/MF A01; 1 (GPO Dep.)	DE84010432	MN -60	9:28238
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1	NTIS, PC A09/MF A01; 1 (GPO Dep.)	DE84012404	STD -66	9:28212
2	NTIS, PC A08/MF A01; 1 (GPO Dep.)	DE84012409	STD -66	9:28213
DOE/RA/50665-				
T1	Western Governors' Policy Office, 3333 Quebec St., Suite 2000, Denver, CO 80207	TI84011395	ND -90	9:27823
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T3	NTIS, PC A07/MF A01; 1 (GPO Dep.)	DE84010341	MN -58a	9:28062
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T1	NTIS MF A01; 2 (GPO Dep.)	DE84011280	MN -97b	9:28547
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84-1	NTIS, PC A03/MF A01; 1 (GPO Dep.)	DE84011822	STD -85	9:27916
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T16	NTIS, PC A02/MF A01 (GPO Dep.)	DE84012214	MN -60	9:28236
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T1-Vol.5	NTIS, PC A15/MF A01; 1 (GPO Dep.)	DE84010908	MN -78	9:28276
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T3	NTIS, PC A06/MF A01; 1 (GPO Dep.)	DE84011457	MN -34D	9:29591
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T29	NTIS, PC A02/MF A01 (GPO Dep.)	DE84012388	MN -28	9:29060
T30	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE84012387	MN -28	9:29096
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01	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE84011448	MN -62	9:28111
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05	NTIS, PC A06/MF A01; 1 (GPO Dep.)	DE84011435	MN -62	9:28115
06	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE84011426	MN -62	9:28116
07	NTIS, PC A03; 3 (GPO Dep.)	DE84011439	MN -62	9:28117
09	NTIS, PC A04/MF A01; 1 (GPO Dep.)	DE84011449	MN -62	9:28118
11	NTIS, PC A02/MF A01 (GPO Dep.)	DE84011433	MN -62	9:28119
13	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE84011438	MN -62	9:28120
16	NTIS, PC A02/MF A01 (GPO Dep.)	DE84012464	MN -62	9:28121
17	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE84012463	MN -62	9:28122
19	NTIS, PC A03/MF A01; 1 (GPO Dep.)	DE84012470	MN -62	9:28123
20-Rev.A	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE84012472	MN -62	9:28124
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T6	NTIS, PC A09/MF A01 (GPO Dep.)	DE84006253	STD -59a	9:28159
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T3	NTIS, PC A16/MF A01; 1 (GPO Dep.)	DE83015607	STD -60	9:28583
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T1	NTIS MF A01; 2 (GPO Dep.)	DE84010420	MN -59	9:28160
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3398	NTIS, PC A11/MF A01	DE82012479	STD -2	9:30059
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1683	NTIS, PC A02/MF A01 (GPO Dep.)	DE84012150	STD -4	9:28957
1684	NTIS, PC A03/MF A01; 1 (GPO Dep.)	DE84012117	STD -10	9:27911
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83-12-Rev.2	NTIS, PC A02/MF A01 (GPO Dep.)	DE84012062	MN -11	9:29206
83-120	NTIS, PC A02/MF A01 (GPO Dep.)	DE84011140	MN -11	9:29306
83-123	NTIS, PC A03/MF A01; 1 (GPO Dep.)	DE84011507	MN -25	9:28767
83-127	NTIS, PC A03/MF A01; 1 (GPO Dep.)	DE84011517	MN -11	9:29304
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67	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE84012860	MN -4	9:28887
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60-25-25	NTIS, PC A02; 3 (GPO Dep.)	DE84012427	MN -11	9:29236
62-25-5	NTIS, PC A02; 3 (GPO Dep.)	DE84012429	MN -11	9:29237
63-25-1	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE84012430	MN -11	9:29238
64-25-1	NTIS, PC A02; 3 (GPO Dep.)	DE84012423	MN -11	9:29239
65-25-1	NTIS, PC A02; 3 (GPO Dep.)	DE84012428	MN -11	9:29240
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80-309	NTIS, PC A03/MF A01; 1 (GPO Dep.)	DE84012063	MN -78	9:28408
80-683	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE84012563	MN -70	9:27937
81-282	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE84012424	MN -70	9:27938
83-128-1	NTIS, PC A06/MF A01; 1 (GPO Dep.)	DE84011141	MN -23	9:28004
83-951	NTIS, PC A02/MF A01 (GPO Dep.)	DE84012421	MN -70	9:27939
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552(39) -82	NTIS (US Sales Only), PC A02/MF A01	DE84701681	MN -34D	9:29783
582(69) -82	NTIS (US Sales Only), PC A02/MF A01	DE84701688	MN -34D	9:29123
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2287	NTIS, PC A03/MF A01; 1 (GPO Dep.)	DE84011793	STD -78	9:28277
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10282-2033	NTIS, PC A02/MF A01 (GPO Dep.)	DE84006669	MN -41	9:29124
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6550	NTIS, PC A03/MF A01; 1 (GPO Dep.)	DE84011886	MN -80	9:28352
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6515	NTIS, PC A03/MF A01 (GPO Dep.)	DE84011906	MN -32	9:30075
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6596	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE84011909	MN -38	9:29039
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09184	NTIS, PC A03/MF A01; 1 (GPO Dep.)	DE84011180	MN -97e	9:28059
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6554-Rev.1	NTIS, PC A03/MF A01; 1 (GPO Dep.)	DE84012169	MN -78	9:28409
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338	*See* ORNL/TM-9023	DE84012026	STD -2	9:29875
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1982	NTIS (US Sales Only), PC A02/MF A01	DE84750662	MN -34D	9:29582
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600/ 6-84-020	*See* DOE/DP/00539-050	DE84011323	MN -11	9:29271
600/ 8-82-029A-F	*See* PB-84-156785			9:29220
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3285-Vol.2	EPRI-RRC, Box 50490, Palo Alto, CA 94303	TI84920373	ND -62a	9:28125
3399	EPRI-RRC, Box 50490, Palo Alto, CA 94303	TI84920323	ND -90g	9:28562
3420	EPRI-Research Reports Center, Box 50490, Palo Alto, CA 94303	TI84920317	ND -90f	9:28549
3426	EPRI-RRC, Box 50490, Palo Alto, CA 94303	TI84920332	ND -90c	9:28031
3429	EPRI-RRC, Box 50490, Palo Alto, CA 94303	TI84920341	ND -21	9:29998
3440	EPRI-RRC, Box 50490, Palo Alto, CA 94303	TI84920359	ND -90c	9:27769
3447	EPRI-Research Reports Center, Box 50490, Palo Alto, CA 94303	TI84920337	ND -60	9:28241
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3369-Vol.1	EPRI-RRC, Box 50490, Palo Alto, CA 94303	TI84920213	ND -90i	9:27797
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3421	Electric Power Research Inst., Research Reports Center, Box 50490, Palo Alto, CA 94303	TI84920346	ND -90i	9:27789
3428	EPRI-RRC, Box 50490, Palo Alto, CA 94303	TI84920316	ND -90h	9:28252
3475	Electric Power Research Inst., Research Reports Center, Box 50490, Palo Alto, CA 94303	TI84920324	ND -90i	9:27799
3503	Electric Power Research Inst., Research Reports Center, P.O. Box 50490, Palo Alto, CA 94303	TI84920327	ND -90a	9:28255
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3456-Vol.1	Electric Power Research Inst., Research Reports Center, P.O. Box 50490, Palo Alto, CA 94303	TI84920370	ND -98A	9:28542
3456-Vol.2	Electric Power Research Inst., Box 50490, Palo Alto, CA 94303	TI84920321	ND -98A	9:27836
3462	EPRI-RRC, Box 50490, Palo Alto, CA 94303	TI84920319	ND -98E	9:28502
3466	NTIS, PC A04/MF A01; 1 - EPRI (GPO Dep.)	DE84012079	MN -11	9:29207
3482	EPRI-RRC, Box 50490, Palo Alto, CA 94303	TI84920356	ND -98E	9:28499
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2561-Vol.6	EPRI-RRC, Box 50490, Palo Alto, CA 94303	TI84920372	ND -97d	9:28550
3106-Vol.4	EPRI-RRC, Box 50490, Palo Alto, CA 94303	TI84920344	ND -97a	9:28532
3192	EPRI-RRC, Box 50490, Palo Alto, CA 94303	TI84920369	ND -97	9:28551
3345	EPRI-RRC, Box 50490, Palo Alto, CA 94303	TI84920350	ND -97	9:29258
3425-CCM-Vol.2	EPRI-RRC, Box 50490, Palo Alto, CA 94303	TI84920362	ND -97a	9:28552
3437	EPRI-RRC, Box 50490, Palo Alto, CA 94303	TI84920371	ND -97	9:28553
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3435	EPRI-RRC, Box 50490, Palo Alto, CA 94303	TI84920354	ND -97e	9:28054
3457	EPRI-RRC, Box 50490, Palo Alto, CA 94303	TI84920338	ND -97c	9:28473
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3198	EPRI-RRC, Box 50490, Palo Alto, CA 94303	TI84920363	ND -78	9:28278
3274-Vol.1	EPRI-RRC, Box 50490, Palo Alto, CA 94303	TI84920312	ND -78	9:28279
3278	EPRI-RRC, Box 50490, Palo Alto, CA 94303	TI84920365	ND -78	9:28280
3412	EPRI-RRC, Box 50490, Palo Alto, CA 94303	TI84920364	ND -78	9:28281
3434	EPRI-RRC, Box 50490, Palo Alto, CA 94303	TI84920335	ND -78	9:28410
3438	Electric Power Research Inst., Box 50490, Palo Alto, CA 94303	TI84920326	ND -11	9:28381
3441	EPRI-RRC, Box 50490, Palo Alto, CA 94303	TI84920358	ND -78	9:28293
3448-Vol.1	EPRI-RRC, Box 50490, Palo Alto, CA 94303	TI84920352	ND -80	9:28411
3448-Vol.2	EPRI-RRC, Box 50490, Palo Alto, CA 94303	TI84920353	ND -80	9:28412
3459-Vol.1	EPRI-RRC, Box 50490, Palo Alto, CA 94303	TI84920368	ND -80	9:28413
3460	Electric Power Research Inst., Research Reports Center, Box 50490, Palo Alto, CA 94303	TI84920347	ND -78	9:28282
3472	EPRI-RRC, Box 50490, Palo Alto, CA 94303	TI84920339	ND -78	9:28283
3477-Vol.1	Electric Power Research Inst., Research Reports Center, P.O. Box 50490, Palo Alto, CA 94303	TI84920325	ND -78	9:28284
3477-Vol.2	EPRI-RRC, Box 50490, Palo Alto, CA 94303	TI84920334	ND -78	9:28285
3481	Electric Power Research Inst., Box 50490, Palo Alto, CA 94303	TI84920349	ND -78	9:28414
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114	*See* DOE/ID/12079-97	DE84012184	MN -66a	9:28208
121	*See* DOE/ID/12079-104	DE84012186	MN -66a	9:28209
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1195	NTIS (US Sales Only), PC A03/MF A01; 1	DE84750605	MN -20	9:29927
1197	NTIS (US Sales Only), PC A03/MF A01	DE84750606	MN -20	9:29928
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2893-129	*See* DOE/ET/10069-T89	DE84011495	MN -90d	9:27720
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1248	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE84012520	MN -41	9:29125
1255	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE84012519	MN -28	9:30076
1256	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE84012515	MN -28	9:29097
1257	NTIS, PC A02/MF A01 (GPO Dep.)	DE84012516	MN -38	9:29044
1258	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE84012517	MN -28	9:29068
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15738	*See* DOE/ET/15322-T6	DE84012386	MN -25	9:28766
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1325	NTIS (US Sales Only), PC A02/MF A01	DE84750664	MN -28	9:29098
1352	NTIS (US Sales Only), PC A06/MF A01	DE84750663	MN -34B	9:29546
1392	NTIS (US Sales Only), PC A06/MF A01	DE84750607	MN -48	9:29382
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80/ 40.1	NTIS, PC A03/MF A01; - GPO*	TI84901175	MN -11	9:29467
80/ 40.2	NTIS, PC A02/MF A01; - GPO*	TI84901177	MN -11	9:29468
80/ 40.14	NTIS, PC A03/MF A01; 1 (GPO Dep.)	DE84011779	MN -11	9:29296
80/ 40.17	NTIS, PC A08/MF A01; 1	TI84901174	MN -11	9:29259
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16955	NTIS, PC A08/MF A01; 1 (GPO Dep.)	DE84012857	MN -85	9:27979
16964	NTIS, PC A06/MF A01; 1 (GPO Dep.)	DE84011587	MN -85	9:27917
17305	NTIS, PC A06; 3 (GPO Dep.)	DE84011588	MN -71	9:27918
17323	NTIS, PC A07/MF A01; 1 (GPO Dep.)	DE84011820	STD -85	9:27919
17388	NTIS, PC A06/MF A01 (GPO Dep.)	DE84010488	STD -77	9:28291
17494	NTIS, PC A02/MF A01 (GPO Dep.)	DE84010936	MN -20a	9:29929
17520	NTIS, PC A02/MF A01 (GPO Dep.)	DE84011178	MN -20a	9:29930
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GAO/RCED-				
84-30	General Accounting Office, P.O. Box 6015, Gaithersburg, MD 20760	TI84901111	MN -13	9:28516
84-34	General Accounting Office, P.O. Box 6015, Gaithersburg, MD 20760	TI84901114	MN -13	9:28489
84-42	General Accounting Office, P.O. Box 6015 Gaithersburg, MD 20760	TI84901113	MN -32	9:28490
84-64	General Accounting Office, P.O. Box 6015 Gaithersburg, MD 20760	TI84901118	MN -2	9:28522
84-70	General Accounting Office, P.O. Box 6015, Gaithersburg, MD 20760	TI84901117	MN -98C	9:27878
84-74	General Accounting Office, P.O. Box 6015, Gaithersburg, MD 20760	TI84901120	MN -20	9:28523
84-76	General Accounting Office, P.O. Box 6015, Gaithersburg, MD 20760; 1	TI84901121	MN -2	9:27897
84-77	General Accounting Office, P.O. Box 6015, Gaithersburg, MD 20760	TI84901119	MN -98C	9:27879
84-106	General Accounting Office, P.O. Box 6015 Gaithersburg, MD 20760	TI84901108	MN -13	9:28491
84-113	General Accounting Office, P.O. Box 6015, Gaithersburg, MD 20760	TI84901110	MN -90c	9:27837
84-129	US General Accounting Office, PO Box 6015, Gaithersburg, MD 20760	TI84901089	MN -13	9:30093
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82AEP022	*See* PB-84-148055			9:29056
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30314	NTIS (US Sales Only), PC A04/MF A01 (GPO Dep.)	DE84011821	STD -78	9:28261
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00693	NTIS, PC A11/MF A01; 1 (GPO Dep.)	DE84010289	STD -77	9:28292
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012	NTIS, PC A06/MF A01; 1 (GPO Dep.)	DE84012366	MN -78	9:28416
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815	NTIS, PC A03/MF A01; 1 (GPO Dep.)	DE84012303	MN -13	9:28005
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695-Vol.2	*See* N-76-18259	TI84901106	MN -25	9:28327
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38(83)	NTIS MF A01; 2 (GPO Dep.)	DE84000421	MN -51	9:27895

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83/ E/ 48	NTIS (US Sales Only), PC A04/MF A01	DE84751598	MN -25	9:28769
83/ E/ 55	NTIS (US Sales Only), PC A04/MF A01	DE84751346	MN -80	9:28391
83/ E/ 57	NTIS (US Sales Only), PC A06/MF A01; 1	DE84751473	MN -04	9:28861
83/ E/ 60	NTIS (US Sales Only), PC A06/MF A01; 1	DE84751476	MN -11	9:29209
83/ E/ 61	NTIS (US Sales Only), PC A03/MF A01; 1	DE84751475	MN -60	9:29187
83/ E/ 64	NTIS (US Sales Only), PC A02; 3	DE84751505	MN -11	9:29297
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686	*See* BMI-1983-014	DE84751342	MN -80	9:28393
786	*See* BMI-1983-008			9:28392
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HEDL-				
7447	NTIS, PC A04/MF A01; 1 (GPO Dep.)	DE84012376	MN -80	9:28770
HEDL-SA-				
2578-FP	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE84010322	MN -80	9:28419
2918-FP	NTIS, PC A02/MF A01 (GPO Dep.)	DE84007168	MN -79	9:28301
2959	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE84006546	MN -79	9:28302
2998-FP	NTIS, PC A02; 3 (GPO Dep.)	DE84010321	MN -80	9:27901
3024-A	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE84010320	MN -20c	9:28771
3061-FP	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE84011473	MN -78	9:27920
3092-S	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE84010317	MN -79g	9:28388
3128-FP	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE84011476	MN -32	9:30077
3131-FP	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE84011474	MN -79b	9:28303
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83-22	*See* NUREG/CR-3391-Vol.2	DE84008921	MN -78	9:28266
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81/ 104	NTIS (US Sales Only), PC A03/MF A01	DE84701642	MN -34D	9:29912
82/ 188	NTIS (US Sales Only), PC A02/MF A01	DE84701667	MN -34D	9:29658
82/ 192	NTIS (US Sales Only), PC A02/MF A01	DE84701643	MN -34D	9:29913
82/ 197	NTIS (US Sales Only), PC A02/MF A01	DE84701660	MN -34D	9:29888
82/ 205	NTIS (US Sales Only), PC A03/MF A01	DE84701656	MN -34D	9:29889
82/ 206	NTIS (US Sales Only), PC A02/MF A01	DE84701661	MN -34D	9:29890
82/ 213	NTIS (US Sales Only), PC A02/MF A01	DE84701662	MN -34D	9:29891
82/ 218	NTIS (US Sales Only), PC A02/MF A01	DE84701684	MN -34D	9:29631
82/ 226	NTIS (US Sales Only), PC A02/MF A01	DE84701644	MN -34D	9:29914
82/ 227	NTIS (US Sales Only), PC A02/MF A01	DE84701645	MN -34D	9:29915
82/ 230	NTIS (US Sales Only), PC A02/MF A01	DE84701668	MN -34D	9:29659
82/ 234	NTIS (US Sales Only), PC A02/MF A01	DE84701669	MN -34D	9:29660
83/ 3	NTIS (US Sales Only), PC A03/MF A01	DE84701664	MN -34D	9:29892
83/ 16	NTIS (US Sales Only), PC A02/MF A01	DE84701679	MN -34B	9:29533
83/ 17	NTIS (US Sales Only), PC A02/MF A01	DE84701678	MN -34B	9:29534
83/ 18	NTIS (US Sales Only), PC A03/MF A01	DE84701663	MN -34D	9:29893
83/ 22	NTIS (US Sales Only), PC A03/MF A01	DE84701670	MN -34D	9:29661
83/ 23	NTIS (US Sales Only), PC A04/MF A01	DE84701676	MN -34A	9:28829
83/ 34	NTIS (US Sales Only), PC A02/MF A01	DE84701665	MN -34D	9:29894
83/ 36	NTIS (US Sales Only), PC A04/MF A01	DE84701673	MN -34D	9:29662
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83/ 42	NTIS (US Sales Only), PC A02/MF A01	DE84701666	MN -34D	9:29663
83/ 46	NTIS (US Sales Only), PC A02/MF A01	DE84701658	MN -34D	9:29896
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83/ 51	NTIS (US Sales Only), PC A02/MF A01	DE84701659	MN -34D	9:29898
83/ 54	NTIS (US Sales Only), PC A02/MF A01	DE84701672	MN -34D	9:29664
83/ 55	NTIS (US Sales Only), PC A04/MF A01	DE84701646	MN -34D	9:29916
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24	Institut fuer Energie- und Umweltforschung e.V., Heidelberg (Germany, F.R.)			9:28524
IIES-dp-				
83-4	NTIS (US Sales Only), PC A06/MF A01; 1	DE84751506	MN -95c	9:28534
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6-FB-7	NTIS (US Sales Only), PC A04/MF A01	DE84751299	MN -78	9:28334
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98	NTIS (US Sales Only), PC A06/MF A01	DE84780186	MN -11	9:29287
99	NTIS (US Sales Only), PC A08/MF A01	DE84780164	MN -20	9:27898
100	NTIS (US Sales Only), PC A07/MF A01	DE84780188	MN -48	9:29432
101	NTIS (US Sales Only), PC A06/MF A01	DE84701921	MN -34D	9:29899
102	NTIS (US Sales Only), PC A06/MF A01	DE84780184	MN -4	9:28862
103	NTIS (US Sales Only), PC A05/MF A01	DE84780190	MN -41	9:28420
104	NTIS (US Sales Only), PC A02/MF A01	DE84780172	MN -34C	9:29797
105	NTIS (US Sales Only), PC A02/MF A01	DE84701922	MN -34D	9:29665
106	NTIS (US Sales Only), PC A02/MF A01	DE84780185	MN -51	9:29524
INIS-mf-				
8343	NTIS (US Sales Only), PC A04/MF A01	DE84780168	MN -34D	9:29596
8348	NTIS (US Sales Only), PC A05/MF A01	DE84780173	MN -34C	9:29808
8364	NTIS (US Sales Only), PC A03/MF A01	DE84780169	MN -34C	9:29870
8369	NTIS (US Sales Only), PC A04/MF A01	DE84780180	MN -34C	9:29764

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8372	NTIS (US Sales Only), PC A08/MF A01	DE84780175	MN -34C	9:29739
8373	NTIS (US Sales Only), PC A06/MF A01	DE84780178	MN -34C	9:29757
8374	NTIS (US Sales Only), PC A04/MF A01	DE84780174	MN -34C	9:29789
8375	NTIS (US Sales Only), PC A04/MF A01	DE84780177	MN -34C	9:29740
8376	NTIS (US Sales Only), PC A05/MF A01	DE84780198	MN -48	9:29384
8377	NTIS (US Sales Only), PC A04/MF A01	DE84780194	MN -48	9:29385
8378	NTIS (US Sales Only), PC A02/MF A01	DE84780207	MN -2	9:28329
8379	NTIS (US Sales Only), PC A02/MF A01	DE84780203	MN -2	9:27894
8380	NTIS (US Sales Only), PC A04/MF A01	DE84780195	MN -48	9:29386
8381	NTIS (US Sales Only), PC A07/MF A01	DE84780193	MN -41	9:29433
8382	NTIS (US Sales Only), PC A05/MF A01	DE84780196	MN -48	9:29387
8383	NTIS (US Sales Only), PC A09/MF A01	DE84780189	MN -23	9:29407
8385	NTIS (US Sales Only), PC A06/MF A01	DE84780171	MN -34C	9:29790
8386	NTIS (US Sales Only), PC A03/MF A01	DE84780187	MN -48	9:29434
8387	NTIS (US Sales Only), PC A08/MF A01	DE84780229	MN -25	9:28773
8388	NTIS (US Sales Only), PC A03/MF A01	DE84780197	MN -48	9:29388
8391	NTIS (US Sales Only), PC A04/MF A01	DE84780236	MN -34A	9:29562
8396	NTIS (US Sales Only), PC A08/MF A01	DE84780237	MN -34A	9:28774
8397	NTIS (US Sales Only), PC A10/MF A01	DE84780199	MN -48	9:29389
8399	NTIS (US Sales Only), PC A07/MF A01	DE84780200	MN -38	9:29013
8400	NTIS (US Sales Only), PC A07/MF A01	DE84780201	MN -38	9:29014
8705	NTIS (US Sales Only), PC A07/MF A01	DE84780217	MN -32	9:29390
8720	NTIS (US Sales Only), PC A04/MF A01	DE84780218	MN -2	9:28525
8920	NTIS (US Sales Only), PC A03/MF A01	DE84780183	MN -4	9:28863
8922	NTIS (US Sales Only), PC A04/MF A01	DE84780208	MN -2	9:28259
8923	NTIS (US Sales Only), PC A07/MF A01	DE84780204	MN -98F	9:28554
8924	NTIS (US Sales Only), PC A06/MF A01	DE84780191	MN -41	9:27969
8926	NTIS (US Sales Only), PC A02/MF A01	DE84780205	MN -2	9:28294
8927	NTIS (US Sales Only), PC A05/MF A01	DE84780240	MN -4	9:28864
8927	NTIS (US Sales Only), PC A05/MF A01	DE84780240	MN -2	9:30060
8928	NTIS (US Sales Only), PC A05/MF A01	DE84780241	MN -25	9:28260
8929	NTIS (US Sales Only), PC A05/MF A01	DE84780242	MN -25	9:28262
8930	NTIS (US Sales Only), PC A05/MF A01	DE84780245	MN -41	9:28263
8932	NTIS (US Sales Only), PC A05/MF A01	DE84780192	MN -41	9:27970
8938	NTIS (US Sales Only), PC A03/MF A01	DE84780257	MN -2	9:27993
INIS-SU-				
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211	NTIS (US Sales Only), PC A04/MF A01	DE84780255	MN -28	9:29061
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82-6	NTIS (US Sales Only), PC A03/MF A01	DE84751331	MN -20	9:29932
82-8	NTIS (US Sales Only), PC A02/MF A01	DE84751324	MN -20g	9:29933
82-9	NTIS (US Sales Only), PC A02/MF A01	DE84751325	MN -20g	9:29934
82-10	NTIS (US Sales Only), PC A02/MF A01	DE84751310	MN -20g	9:29935
82-14	NTIS (US Sales Only), PC A05/MF A01	DE84751323	MN -20	9:29936
82-15	NTIS (US Sales Only), PC A03/MF A01	DE84751332	MN -20	9:29937
82-16	NTIS (US Sales Only), PC A03/MF A01	DE84751333	MN -20	9:29938
82-17	NTIS (US Sales Only), PC A02/MF A01	DE84751319	MN -20a	9:30001
82-18	NTIS (US Sales Only), PC A04/MF A01	DE84751320	MN -20	9:29939
83-2	NTIS (US Sales Only), PC A02/MF A01	DE84751341	MN -20	9:29940
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1/ 217	NTIS (US Sales Only), PC A08/MF A01	DE84751318	MN -20	9:30002
1/ 218	NTIS (US Sales Only), PC A05/MF A01	DE84751289	MN -21	9:30003
1/ 219	NTIS (US Sales Only), PC A06/MF A01	DE84751290	MN -21	9:30004
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464	NTIS, PC A03/MF A01 (GPO Dep.)	DE84012838	MN -25	9:28805
477	NTIS, PC A02/MF A01 (GPO Dep.)	DE84012839	MN -90a	9:27772
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12	NTIS (US Sales Only), PC A14/MF A01; 1	DE84900985	MN -78	9:28264
16	NTIS (US Sales Only), PC A18/MF A01; 1	DE84900983	MN -78	9:28421
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E-2-82-386	NTIS (US Sales Only), PC A02/MF A01	DE84701680	MN -34B	9:29541
E-2-83-101	NTIS (US Sales Only), PC A02/MF A01	DE84701691	MN -34C	9:29822
E-2-83-281	NTIS (US Sales Only), PC A02/MF A01	DE84701647	MN -34D	9:29917
E-2-83-301	NTIS (US Sales Only), PC A02/MF A01	DE84701648	MN -34D	9:29668
E-2-83-415	NTIS (US Sales Only), PC A02/MF A01	DE84701692	MN -34C	9:29823
E-4-83-421	NTIS (US Sales Only), PC A02/MF A01	DE84701693	MN -34C	9:29824
E-5-83-228	NTIS (US Sales Only), PC A02/MF A01	DE84701649	MN -34D	9:29669
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1-83-306	NTIS (US Sales Only), PC A02/MF A01	DE84701689	MN -34D	9:29604
2-83-76	NTIS (US Sales Only), PC A02/MF A01	DE84701654	MN -34D	9:29905
2-83-83	NTIS (US Sales Only), PC A02/MF A01	DE84701683	MN -34D	9:29633

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2-83-377	NTIS (US Sales Only), PC A02/MF A01	DE84701653	MN -34D	9:29906
3-83-133	NTIS (US Sales Only), PC A02/MF A01	DE84701674	MN -34A	9:28914
3-83-180	NTIS (US Sales Only), PC A02/MF A01	DE84701690	MN -46	9:29872
4-83-135	NTIS (US Sales Only), PC A02/MF A01	DE84701655	MN -34D	9:29687
11-83-329	NTIS (US Sales Only), PC A02/MF A01	DE84701650	MN -34D	9:29671
17-83-33	NTIS (US Sales Only), PC A02/MF A01	DE84701651	MN -34D	9:29672
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1820	NTIS (US Sales Only), PC A04/MF A01	DE84751339	MN -20	9:30006
1822	NTIS (US Sales Only), PC A03/MF A01	DE84751328	MN -04	9:28873
1830	NTIS (US Sales Only), PC A03/MF A01	DE84751340	MN -20g	9:29952
1849	NTIS (US Sales Only), PC A04/MF A01	DE84751294	MN -25	9:28785
1866	NTIS (US Sales Only), PC A04/MF A01	DE84751334	MN -80	9:28353
Juel-Spez-				
229	NTIS (US Sales Only), PC A03/MF A01	DE84751343	MN -20	9:30007
K/PS-				
449	NTIS, PC A02/MF A01 (GPO Dep.)	DE84011589	MN -4	9:27899
452	NTIS, PC A02/MF A01 (GPO Dep.)	DE84011908	MN -4	9:27900
773	NTIS, PC A02/MF A01 (GPO Dep.)	DE84012308	MN -4	9:28948
5020	NTIS, PC A02/MF A01 (GPO Dep.)	DE84012393	MN -4	9:28915
5033	NTIS, PC A02/MF A01 (GPO Dep.)	DE84006434	MN -4	9:28786
KFK-				
2992	NTIS (US Sales Only), PC A03/MF A01; 1	DE84751597	MN -11	9:29298
3374-B	NTIS (US Sales Only), PC A08/MF A01	DE84780152	MN -25	9:28806
3400	NTIS (US Sales Only), PC A07/MF A01	DE84751336	MN -80	9:28422
3469	NTIS (US Sales Only), PC A05/MF A01	DE84751306	MN -80	9:28286
3484	NTIS (US Sales Only), PC A03/MF A01	DE84751326	MN -11	9:28423
3505	NTIS (US Sales Only), PC A11/MF A01	DE84751327	MN -79	9:28304
3525	NTIS (US Sales Only), PC A04/MF A01; 1	DE84751594	MN -88	9:27838
3540	NTIS (US Sales Only), PC A10/MF A01	DE84751298	MN -79p	9:28424
3543	NTIS (US Sales Only), PC A10/MF A01	DE84751330	MN -79	9:28335
3545	NTIS (US Sales Only), PC A03/MF A01	DE84751308	MN -11	9:29210
3552	NTIS (US Sales Only), PC A06/MF A01	DE84751350	MN -80	9:28425
3553	NTIS (US Sales Only), PC A03/MF A01	DE84751291	MN -34C	9:29692
3555	NTIS (US Sales Only), PC A03/MF A01	DE84751305	MN -34C	9:29753
3556	NTIS (US Sales Only), PC A04/MF A01	DE84751304	MN -34C	9:29825
3584	NTIS (US Sales Only), PC A04/MF A01	DE84751297	MN -20b	9:30008
3591	NTIS (US Sales Only), PC A04/MF A01	DE84751309	MN -79	9:28426
3599	NTIS (US Sales Only), PC A09/MF A01; 1	DE84751224	MN -11	9:29299
3601	NTIS (US Sales Only), PC A07/MF A01	DE84751307	MN -79	9:28427
3605	NTIS (US Sales Only), PC A06/MF A01	DE84751596	MN -25	9:28787
3610	NTIS (US Sales Only), PC A05/MF A01	DE84751303	MN -34D	9:29605
3638	NTIS (US Sales Only), PC A02/MF A01	DE84751347	MN -34	9:29132
3647	NTIS (US Sales Only), PC A06/MF A01	DE84751345	MN -28	9:29099
KTECH-TR-				
80-01-Vol.2	NTIS, PC A03/MF A01; 1 (GPO Dep.)	DE84012282	MN -45	9:29159
81-12-Vol.1	NTIS, PC A03/MF A01; 1 (GPO Dep.)	DE84012203	MN -45	9:29160
LA-				
9776-MS	*See* NUREG/CR-3305	DE84011866	MN -80	9:28439
10042-MS	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE84010995	STD -34	9:29953
LA-tr-				
82-26	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE83000343	MN -32	9:30092
83-12	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE84012220	MN -4	9:28926
83-24	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE84012557	MN -25	9:28801
83-27	NTIS, PC A03/MF A01; 1 (GPO Dep.)	DE84004461	MN -86	9:27914
83-29	NTIS, PC A02/MF A01 (GPO Dep.)	DE84005000	MN -86	9:27915
LA-UR-				
83-1294	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE84011328	MN -59b	9:28161
83-3084	NTIS PC A03/MF A01	DE84001725	MN -32	9:30078
83-3514	NTIS, PC A03/MF A01 (GPO Dep.)	DE84004333	MN -79h	9:28319
83-3549	NTIS, PC A02/MF A01 (GPO Dep.)	DE84004320	MN -32	9:30079
84-1026	NTIS, PC A05; 3 (GPO Dep.)	DE84009983	MN -34C	9:29690
84-1154	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE84011336	MN -21	9:30009
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84-1186	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE84011373	MN -66a	9:28227
84-1192	NTIS, PC A02; 3 (GPO Dep.)	DE84011349	MN -66b	9:28228
84-1194	NTIS, PC A02/MF A01; 1	DE84011351	MN -66b	9:28229
84-1199	NTIS, PC A03/MF A01; 1 (GPO Dep.)	DE84011352	MN -34B	9:29547
84-1208	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE84011372	MN -66b	9:28214
84-1245	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE84011370	MN -48	9:29408
84-1249	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE84011369	MN -20f	9:29954
84-1277	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE84011368	MN -28	9:29070
84-1278	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE84011367	MN -28	9:29100
84-1281	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE84011408	MN -28	9:29071
84-1306	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE84011375	MN -28	9:29062
84-1307	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE84011341	MN -34A	9:29072
84-1311	NTIS, PC A02/MF A01 (GPO Dep.)	DE84011329	MN -34D	9:29673
84-1324	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE84011342	MN -32	9:30080
84-1327	NTIS, PC A03/MF A01; 1 (GPO Dep.)	DE84011410	MN -34D	9:29606
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84-1343	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE84011385	MN -28	9:29073
84-1354	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE84011409	MN -20c	9:30010
84-1359	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE84011412	MN -28	9:29063
84-1375	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE84011415	MN -28	9:29064

Report No.	Availability	Order No.	Distribution Category	Abstract No.
84-1390	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE84011346	MN -15	9:27994
84-1391	NTIS, PC A03/MF A01 (GPO Dep.)	DE84011353	MN -34B	9:29548
84-1399	NTIS, PC A02/MF A01 (GPO Dep.)	DE84011365	MN -11	9:29253
84-1428	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE84012662	MN -59a	9:28163
84-1517	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE84012632	MN -15	9:27995
84-1726	NTIS, PC A02/MF A01 (GPO Dep.)	DE84012578	MN -41	9:29172
LBL-				
16281	NTIS, PC A99/MF A01 (GPO Dep.)	DE84005862	STD -34C	9:29691
16379	NTIS, PC A03/MF A01; 1 (GPO Dep.)	DE84012247	MN -48	9:29435
16405	NTIS, PC A02; 3 (GPO Dep.)	DE84010717	MN -4	9:28874
16893	NTIS, PC A02/MF A01 (GPO Dep.)	DE84004633	MN -4	9:28358
17019	NTIS, PC A02; 3 (GPO Dep.)	DE84010801	MN -91	9:27893
17070	NTIS, PC A04/MF A01; 1 (GPO Dep.)	DE84011424	STD -13	9:28855
17294-Summ.	NTIS, PC A02/MF A01	DE84009246	MN -34A	9:29570
17390	NTIS, PC A02/MF A01 (GPO Dep.)	DE84009237	MN -34	9:28875
17520	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE84010783	MN -11	9:28835
17579	NTIS, PC A09/MF A01; 1 (GPO Dep.)	DE84012164	MN -4	9:28916
17654	NTIS, PC A08/MF A01; 1 (GPO Dep.)	DE84012056	MN -48	9:29326
17666	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE84012055	MN -4	9:28973
17684	NTIS, PC A10/MF A01 (GPO Dep.)	DE84011916	MN -63	9:28074
17704	NTIS, PC A09/MF A01; 1 (GPO Dep.)	DE84011515	MN -48	9:29354
17712	NTIS, PC A08/MF A01; 1 (GPO Dep.)	DE84012311	MN -48	9:29327
17716	NTIS, PC A07/MF A01; 1 (GPO Dep.)	DE84012256	MN -66b	9:28215
17740	NTIS, PC A17/MF A01; 1 (GPO Dep.)	DE84011816	MN -90i	9:27800
LBL-PUB-				
426-Rev.	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE84012159	MN -2	9:30063
3040	NTIS, PC A03/MF A01; 1 (GPO Dep.)	DE84012313	MN -41	9:29512
LMF-				
104	NTIS, PC A02/MF A01 (GPO Dep.)	DE84012995	STD -48	9:29328
108	*See* NUREG/CR-3745	DE84012469	MN -41	9:29439
MCR-				
78-1323	*See* DOE/ET/21007-1	DE84011217	MN -62	9:28107
78-1330	*See* DOE/ET/21007-2	DE84011218	MN -62	9:28108
78-1331B	*See* DOE/SF/10539-03	DE84011447	MN -62	9:28113
79-1302	*See* DOE/ET/21007-3	DE84011219	MN -62	9:28109
79-1352B	*See* DOE/SF/10539-01	DE84011448	MN -62	9:28111
80-1304	*See* DOE/SF/10539-02	DE84011436	MN -62	9:28112
80-1362	*See* DOE/SF/10539-06	DE84011426	MN -62	9:28116
80-1376	*See* DOE/SF/10539-07	DE84011439	MN -62	9:28117
81-1709A	*See* DOE/SF/10539-09	DE84011449	MN -62	9:28118
81-1770	*See* DOE/SF/10539-11	DE84011433	MN -62	9:28119
82-1701	*See* DOE/SF/10539-13	DE84011438	MN -62	9:28120
MEA-				
2028	*See* NUREG/CR-3506	DE84901084	MN -78	9:28788
2030	*See* NUREG/CR-3546	DE84901128	MN -78	9:28789
MIT-EL-				
83-003	NTIS, PC A16/MF A01; 1 (GPO Dep.)	DE84011316	MN -79a	9:28428
83-011	*See* PB-84-162346			9:28453
MLM-				
1418	NTIS, PC A03/MF A01; 1 (GPO Dep.)	DE84010297	MN -23	9:28006
3143	NTIS, PC A03/MF A01; 1 (GPO Dep.)	DE84012991	STD -41	9:29241
MPQ-				
73	NTIS (US Sales Only), PC A02/MF A01	DE84751296	MN -20f	9:29874
MTR-				
79W00104	NTIS, PC A08/MF A01; 1 (GPO Dep.)	DE84010994	MN -62d	9:28126
83W87-01	NTIS, PC A04/MF A01; 1 (GPO Dep.)	DE84011223	STD -90d	9:27827
83W87-02	NTIS, PC A08/MF A01; 1 (GPO Dep.)	DE84011224	STD -90d	9:27828
83W87-03	NTIS, PC A10/MF A01; 1 (GPO Dep.)	DE84011225	STD -90d	9:27829
83W87-04	NTIS, PC A03/MF A01; 1 (GPO Dep.)	DE84011222	STD -90d	9:27830
83W235	*See* DOE/ET/13800-6	DE84008292	STD -90d	9:27721
N-				
76-18259	NTIS, PC A11/MF A01	TI84901106	MN -25	9:28327
NADC-				
83055-60	*See* AD-A-137130/1			9:28978
NASA/CR-				
3344	NTIS, PC A03/MF A01; 1 (GPO Dep.)	DE84012299	MN -63	9:28093
134816-Vol.2	*See* N-76-18259	TI84901106	MN -25	9:28327
174644	*See* DOE/NASA-0266-1	DE84009884	STD -96	9:28700
174677	*See* DOE/NASA-0337-1	DE84012274	STD -60	9:28239
NASA-TM-				
83581	*See* DOE/NASA/20320-57	DE84006794	STD -60	9:28240
83649	*See* DOE/NASA-1005-2	DE84010761	STD -96	9:28710
NBS-BSS-				
153	*See* PB-84-154004			9:28589
NBS-TN-				
1187	NTIS, PC A11/MF A01; 1 (GPO Dep.)	DE84010817	STD -59	9:28164
NBSIR-				
84-2845	NTIS, PC A07/MF A01; 1 (GPO Dep.)	DE84010545	STD -59	9:28165
NIPER-				
134-PPS-84/ 2	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE84011823	STD -92b	9:27872
NIS-				
633	Nuklear-Ingenieur Service G.m.b.H., Hanau (Germany, F.R.)			9:28429
NMERDI-				
2-68-3308	NTIS, PC A15/MF A01; 1	DE84901074	MN -92a	9:27845

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2-69-2208	New Mexico Energy Research Development Institute Center, Univ. of New Mexico, 457 Washington, SE, Albuquerque, NM 87108	TI84900886	MN -66b	9:28216
2-71-4518	New Mexico Energy Research and Development Institute Information Ctr., University of New Mexico, Suite M, 457 Washington SE, Albuquerque, NM 87108	TI84900891	MN -59c	9:28166
NOAA-TM-ERL-WPL-				
113	*See* PB-84-150168			9:29530
NP-				
4770255	NTIS (US Sales Only), PC A04/MF A01	DE84770255	MN -13	9:30064
4770256	NTIS (US Sales Only), PC A02/MF A01	DE84770256	MN -92	9:27848
4770257	NTIS (US Sales Only), PC A02/MF A01	DE84770257	MN -94	9:28675
4770258	NTIS (US Sales Only), PC A02/MF A01	DE84770258	MN -94c	9:28676
4770259	NTIS (US Sales Only), PC A02/MF A01	DE84770259	MN -94c	9:28480
4770260	NTIS (US Sales Only), PC A08/MF A01; 1	DE84770260	MN -96	9:28702
4770261	NTIS (US Sales Only), PC A08/MF A01	DE84770261	MN -38	9:29015
4770262	NTIS (US Sales Only), PC A06/MF A01; 1	DE84770262	MN -90a	9:27773
4770263	NTIS (US Sales Only), PC A13/MF A01; 1	DE84770263	MN -92	9:27858
4770270	NTIS (US Sales Only), PC A07/MF A01; 1	DE84770270	MN -98E	9:28555
4770271	NTIS (US Sales Only), PC A07/MF A01; 1	DE84770271	MN -95d	9:28585
4770272	NTIS (US Sales Only), PC A06/MF A01; 1	DE84770272	MN -98F	9:28536
4770273	NTIS (US Sales Only), PC A10/MF A01; 1	DE84770273	MN -88	9:27824
4770274	NTIS (US Sales Only), PC A07/MF A01; 1	DE84770274	MN -97a	9:28257
4770275	NTIS (US Sales Only), PC A05/MF A01; 1	DE84770275	MN -61E	9:29400
4770276	NTIS (US Sales Only), PC A07/MF A01; 1	DE84770276	MN -90c	9:27774
4770278	NTIS (US Sales Only), PC A06/MF A01; 1	DE84770278	MN -96	9:28703
4770279	NTIS (US Sales Only), PC A17/MF A01; 1	DE84770279	MN -11	9:28876
4900941	WVGES, Mont Chateau Research Center, Morgantown, WV	TI84900941	MN -11	9:28512
4901090	NTIS, PC A11/MF A01; 1	DE84901090	MN -95d	9:28586
4901102	NTIS, PC A05/MF A01; 1	DE84901102	MN -88	9:27815
4901103	Meteorology International Inc., PO Box 22920, Carmel, CA 93922	TI84901103	MN -11	9:29288
4901193	Arizona Solar Energy Commission, Capital Tower, Room 502, 1700 West Washington, Phoenix, AZ 85007, $3.00	TI84901193	MN -59b	9:28167
4901194	NTIS, PC A04/MF A01; 1	DE84901194	MN -98	9:28557
4901215	Arizona Solar Energy Commission, Capital Tower, Room 502, 1700 West Washington, Phoenix, AZ 85007, $3.00	TI84901215	MN -59a	9:28168
4901229	Arizona Solar Energy Commission, Capital Tower, Room 502, 1700 West Washington St., Phoenix, AZ 85007	TI84901229	MN -59a	9:28186
4901235	OCS Information Program, Minerals Management Service, 12203 Sunrise Valley Dr., MS 640, Reston, VA 22091	TI84901235	MN -92	9:27859
4901236	OCS Information Program, Minerals Management Service, 12203 Sunrise Valley Drive, Reston, VA 22091	TI84901236	MN -92	9:27860
4901237	OCS Information Program, Minerals Management Services, 12203 Sunrise Valley Dr., MS 640, Reston, VA 22091	TI84901237	MN -92	9:27861
4901238	OCS Information Program, Minerals Management Service, 12203 Sunrise Valley Dr., MS 640, Reston, VA 22091	TI84901238	MN -92	9:27862
4901257	NTIS, PC A10/MF A01; 1	DE84901257	MN -98F	9:28517
NRL-MR-				
5248	*See* AD-A-137105/3			9:29867
NSMRL-				
1014	*See* AD-A-137288/7			9:28979
NSRDS-NBS-				
63-SUPPL-2	*See* PB-84-156496			9:28879
NUREG-				
0020-Vol.8-No.3	NTIS, PC A17/MF A01; 1 - GPO*	DE84901226	MN -80	9:28265
0420-Suppl.5	NTIS, PC A03/MF A01; 1 - GPO* $3.75	DE84901088	MN -78	9:28430
0540-Vol.6-No.1	NTIS, PC A25/MF A01; 1 - GPO*	DE84901205	MN -2	9:28526
0540-Vol.6-No.2	NTIS, PC A99/MF A01; 1 - GPO*	DE84901095	MN -2	9:28527
0748-Vol.4-No.3	NTIS, PC A16/MF A01; 1 - GPO*	DE84901138	MN -80	9:28330
0837-Vol.3-No.4	NTIS, PC A11/MF A01; 1 - GPO*	DE84901197	MN -11	9:29272
0876-Suppl.4	NTIS, PC A03/MF A01 - GPO* $3.75	DE84901183	MN -78	9:28431
0927-Rev.1	NTIS, PC A05/MF A01 - GPO* $4.50	DE84900973	MN -78	9:28432
0974-FINAL	NTIS, PC A99; 3 - GPO* $12.00	DE84901058	MN -78	9:28382
0975-Vol.2	NTIS, PC A14/MF A01; 1 - GPO* $7.50	DE84901057	MN -38	9:28354
0989	NTIS, PC A25/MF A01; 1 - GPO* $11.00	DE84901091	MN -78	9:28433
1028	NTIS, PC A07/MF A01; 1 - GPO* $5.50	DE84901081	MN -11	9:29436
1051	NTIS, PC A04/MF A01; 1 - GPO* $4.50	DE84901250	MN -41	9:28434
1055	NTIS, PC A22/MF A01; 1 - GPO	DE84901187	MN -80	9:28331
1065	NTIS, PC A03/MF A01; 1 - GPO $4.50 (GPO Dep.)	DE84012562	MN -15	9:27996
1066	NTIS, PC A09/MF A01; 1 - GPO* $6.00	DE84901248	MN -78	9:28332
1071	NTIS, PC A06/MF A01; 1 - GPO $5.00	DE84901185	MN -11	9:27971
NUREG/BR-				
0058-Rev.1	NTIS, PC A03/MF A01 - GPO*	DE84901249	MN -2	9:28333
NUREG/CR-				
2000-Vol.3-No.3	NTIS, PC A08/MF A01; 1 - GPO (GPO Dep.)	DE84008540	MN -80	9:28435
2000-Vol.3-No.4	NTIS, PC A09/MF A01; 1 - GPO (GPO Dep.)	DE84012064	MN -80	9:28436
2613	NTIS, PC A08/MF A01; 1 - GPO* $5.50	DE84901092	MN -70	9:27944
2803	NTIS, PC A03/MF A01 - GPO $3.75 (GPO Dep.)	DE84012491	MN -11	9:29289
2940	NTIS, PC A11/MF A01; 1 - GPO (GPO Dep.)	DE84008499	MN -78	9:28437
2955	NTIS, PC A04/MF A01; 1 - GPO $4.50 (GPO Dep.)	DE84012057	MN -41	9:27980
3300-Vol.1	NTIS, PC A21/MF A01; 1 - GPO $9.50 (GPO Dep.)	DE84012384	MN -78	9:28438
3305	NTIS, PC A04/MF A01 - GPO $4.00 (GPO Dep.)	DE84011866	MN -80	9:28439
3335	NTIS, PC A04/MF A01; 1 - GPO (GPO Dep.)	DE84010352	MN -78	9:28359

Report No.	Availability	Order No.	Distribution Category	Abstract No.
3391-Vol.2	NTIS, PC A06/MF A01; 1 - GPO $5.00 (GPO Dep.)	DE84008921	MN -78	9:28266
3422-Vol.3	NTIS, PC A03/MF A01; 1 - GPO (GPO Dep.)	DE84010349	MN -79p	9:28440
3488-Vol.2	NTIS, PC A99/MF A01; 1 - GPO* $16.00	DE84901149	MN -11	9:29211
3506	NTIS, PC A99/MF A01; 1 - GPO* $11.00	DE84901084	MN -78	9:28788
3514	NTIS, PC A03/MF A01; 1 - GPO (GPO Dep.)	DE84010344	MN -78	9:28917
3515	NTIS, PC A08/MF A01; 1 (GPO Dep.)	DE84008552	MN -80	9:28441
3535	NTIS, PC A04/MF A01; - GPO (GPO Dep.)	DE84008313	MN -79p	9:29437
3546	NTIS, PC A03/MF A01; 1 - GPO* $3.75	DE84901128	MN -78	9:28789
3572	NTIS, PC A05/MF A01; 1 - GPO (GPO Dep.)	DE84010646	MN -41	9:29438
3595	NTIS, PC A07/MF A01; 1 - GPO (GPO Dep.)	DE84011865	MN -78	9:28267
3629	NTIS, PC A05/MF A01; 1 - GPO (GPO Dep.)	DE84011840	MN -80	9:28442
3632	NTIS (US Sales Only), PC A03/MF A01 - GPO $3.75 (GPO Dep.)	DE84012154	MN -78	9:28443
3633-Vol.3	NTIS PC E07/MF $7.25; 1 - GPO (GPO Dep.)	DE84011597	MN -78	9:28444
3639	NTIS, PC A04/MF A01; 1 - GPO $4.50 (GPO Dep.)	DE84012523	MN -78	9:28445
3641	NTIS, PC A04/MF A01; 1 - GPO (GPO Dep.)	DE84010823	MN -78	9:28287
3664	NTIS, PC A19/MF A01; 1 - GPO (GPO Dep.)	DE84010607	MN -78	9:28268
3681-Draft	NTIS, PC A16/MF A01; 1 - GPO $8.00 (GPO Dep.)	DE84011213	MN -11	9:28446
3682	NTIS, PC A08/MF A01 - GPO 5.00 (GPO Dep.)	DE84012153	MN -83	9:27981
3683	NTIS, PC A04/MF A01; 1 - GPO $4.25 (GPO Dep.)	DE84012163	MN -83	9:27982
3696	NTIS, PC A07/MF A01; 1 - GPO $5.50 (GPO Dep.)	DE84011673	MN -80	9:28364
3700	NTIS, PC A10/MF A01; 1 - GPO* $6.50	DE84901251	MN -80	9:284-7
3725	NTIS, PC A06/MF A01 - GPO $5.00 (GPO Dep.)	DE84012059	MN -80	9:28365
3741-Vol.1	NTIS, PC A07/MF A01; 1 - GPO* $5.50	DE84901093	MN -80	9:28269
3745	NTIS, PC A03/MF A01; 1 - GPO $4.00 (GPO Dep.)	DE84012469	MN -41	9:29439
3748	NTIS (US Sales Only), PC A05/MF A01; 1 - GPO $4.75 (GPO Dep.)	DE84012073	MN -78	9:28448
3753	NTIS, PC A03/MF A01; 1 - GPO $3.75 (GPO Dep.)	DE84012816	MN -25	9:29030
3754	NTIS, PC A03/MF A01 - GPO* $3.75	DE84901104	MN -78	9:28270
3762	NTIS, PC A04/MF A01; 1 - GPO (GPO Dep.)	DE84011359	MN -80	9:28449
NYSERDA-				
83-23	NYSERDA, Two Rockefeller Plaza, Albany, NY 12223	TI84901148	MN -61A	9:28047
ORAU-				
222	NTIS, PC A07/MF A01; 1 (GPO Dep.)	DE84011379	MN -13	9:30065
225	NTIS, PC A06/MF A01 (GPO Dep.)	DE84010692	STD -41	9:29440
226	NTIS, PC A02/MF A01 (GPO Dep.)	DE84012566	MN -41	9:29513
ORAU/IEA-				
83-11(M)	NTIS, PC A03/MF A01; 1 (GPO Dep.)	DE84012272	MN -78	9:28450
ORNL-				
6009	NTIS, PC A09/MF A01 (GPO Dep.)	DE84010672	STD -11	9:29300
6017	NTIS, PC A10/MF A01 (GPO Dep.)	DE84012069	MN -41	9:29469
6021	NTIS, PC A12/MF A01 (GPO Dep.)	DE84006248	STD -48	9:29441
6037	NTIS, PC A10/MF A01; 1 (GPO Dep.)	DE84012043	STD -4	9:30055
6055	NTIS, PC A99/MF A01; 1 (GPO Dep.)	DE84012049	MN -11	9:29213
ORNL/CON-				
104	NTIS PC E07/MF $5.75; 1 (GPO Dep.)	DE84011857	MN -95d	9:28587
ORNL/CSD/TM-				
162	NTIS, PC A06/MF A01; 1 (GPO Dep.)	DE84012045	MN -32	9:30081
ORNL/EIS-				
203	NTIS, PC A08/MF A01; 1 (GPO Dep.)	DE84011586	MN -41	9:29495
ORNL/FEDC-				
83/ 10	NTIS, PC A04/MF A01 (GPO Dep.)	DE84012040	STD -20d	9:30011
ORNL/NSIC-				
200-Vol.3-No.3	*See* NUREG/CR-2000-Vol.3-No.3	DE84008540	MN -80	9:28435
200-Vol.3-No.4	*See* NUREG/CR-2000-Vol.3-No.4	DE84012064	MN -80	9:28436
ORNL/Sub-				
78-7229/ 5	NTIS, PC A05/MF A01; 1 (GPO Dep.)	DE84011827	STD -95d	9:28677
79/ 33200/ 16	NTIS, PC A03/MF A01 (GPO Dep.)	DE84011717	MN -20a	9:30012
80-7974/ 1	NTIS, PC A12/MF A01; 1 (GPO Dep.)	DE84012027	STD -97b	9:28258
81/ 24707/ 3	NTIS, PC A18/MF A01; 1 (GPO Dep.)	DE84009529	MN -90d	9:27775
83-28915/ 1	NTIS, PC A05/MF A01; 1 (GPO Dep.)	DE84012020	STD -94a	9:28476
ORNL/TM-				
8517	*See* NUREG/CR-2940	DE84008499	MN -78	9:28437
8664	*See* NUREG/CR-3514	DE84010344	MN -78	9:28917
8793	*See* NUREG/CR-3335	DE84010352	MN -78	9:28359
8849/ V3	*See* NUREG/CR-3422-Vol.3	DE84010349	MN -79p	9:28440
8857	NTIS, PC A07/MF A01 (GPO Dep.)	DE84012041	MN -11	9:29260
8914	NTIS, PC A04/MF A01; 1	DE84011828	STD -94a	9:28477
8923	NTIS, PC A05/MF A01; 1 (GPO Dep.)	DE84011724	MN -32	9:30066
8928	NTIS, PC A04/MF A01; 1 (GPO Dep.)	DE84012039	MN -13	9:30094
8929	*See* NUREG/CR-3535	DE84008313	MN -79p	9:29437
8939	*See* NUREG/CR-3572	DE84010646	MN -41	9:29438
8942	*See* NUREG/CR-3515	DE84008552	MN -80	9:28441
9008	*See* NUREG/CR-3595	DE84011865	MN -78	9:28267
9013	NTIS PC E08/MF A01 (GPO Dep.)	DE84012036	MN -95d	9:28695
9023	NTIS, PC A03/MF A01 (GPO Dep.)	DE84012026	STD -2	9:29875
9037	NTIS, PC A02/MF A01 (GPO Dep.)	DE84012037	MN -48	9:29392
9056	NTIS, PC A02/MF A01 (GPO Dep.)	DE84012021	MN -70B	9:27947
9098	NTIS, PC A05/MF A01; 1 (GPO Dep.)	DE84011855	MN -95e	9:28678
9173	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE84012038	MN -80	9:28389
ORNL-tr-				
5110	NTIS, PC A03/MF A01 (GPO Dep.)	DE84010655	MN -70	9:27967

Report No.	Availability	Order No.	Distribution Category	Abstract No.
PATENTS-US-	(US: Commissioner of Patents, Washington, D.C. 20231, USA, $1.00 per copy. Government Patent Applications available from NTIS)			
A 6-491,134		DE84010958	MN -38	9:28992
A 6-492,925		DE84010961	MN -94c	9:28890
A 6-494,482		DE84011079	MN -61E	9:28049
A 6-498,435		DE84011084	MN -38	9:28991
A 6-500,112		DE84011076	MN -37	9:29165
A 6-501,312		DE84011093	MN -38	9:29050
A 6-505,011		DE84011101	MN -38	9:28990
A 6-509,076		DE84011105	MN -63	9:28088
A 6-509,554		DE84011108	MN -38	9:29049
A 6-512,059		DE84011113	MN -63e	9:28087
A 6-513,523		DE84011115	MN -93	9:28569
A 6-513,557		DE84011116	MN -20f	9:29975
A 6-517,477		DE84011031	MN -20	9:30046
A 6-517,531		DE84012754	MN -45	9:29164
A 6-518,243		DE84011035	MN -38	9:29033
A 6-523,990		DE84011233	MN -20c	9:30045
A 6-526,765		DE84011271	MN -38	9:28989
A 6-526,767		DE84011308	MN -38	9:29022
A 6-528,278		DE84011305	MN -28	9:29111
A 6-532,430		DE84011303	MN -60	9:28244
A 6-535,979		DE84011300	MN -37	9:29021
PB-				
84-143692	NTIS, PC A02/MF A01			9:29308
84-145119	NTIS, PC A07/MF A01			9:29214
84-145796	NTIS, PC A02/MF A01			9:29242
84-146448	NTIS, PC A10/MF A01			9:27804
84-146455	NTIS, PC A06/MF A01			9:27805
84-147453	NTIS, PC A06/MF A01			9:29251
84-148055	NTIS, PC A11/MF A01			9:29056
84-148170	NTIS, PC A03/MF A01			9:29215
84-148188	NTIS, PC A09/MF A01			9:29284
84-148485	NTIS PC E03/MF E01			9:29161
84-148493	NTIS PC E13/MF E01			9:29529
84-148535	NTIS, PC A09/MF A01			9:27816
84-148568	NTIS, PC A04/MF A01			9:28328
84-148600	NTIS, PC A17/MF A01			9:28057
84-148733	NTIS, PC A04/MF A01			9:29309
84-148931	NTIS, PC A02/MF A01			9:29216
84-148972	NTIS, PC A07/MF A01			9:29261
84-149087	NTIS, PC A11/MF A01			9:29310
84-149467	NTIS, PC A02/MF A01			9:29217
84-150168	NTIS, PC A03/MF A01			9:29530
84-150192	NTIS, PC A05/MF A01			9:29243
84-150671	NTIS PC 03/MF E01			9:28056
84-150911	NTIS, PC A04/MF A01			9:29283
84-151166	NTIS, PC A03/MF A01			9:27825
84-151307	NTIS, PC A10/MF A01			9:29525
84-151653	NTIS, PC A03/MF A01			9:28679
84-151695	NTIS, PC A05/MF A01			9:27849
84-152024	NTIS, PC A09/MF A01			9:27873
84-152057	NTIS, PC A09/MF A01			9:28680
84-152107	NTIS, PC A03/MF A01			9:28877
84-152123	NTIS, PC A03/MF A01			9:27817
84-152156	NTIS, PC A02/MF A01			9:28790
84-152164	NTIS, PC A02/MF A01			9:27818
84-152461	Pub. in Proceedings of Polynuclear Aromatic Hydrocarbons: International Symposium on Formation, Metabolism, Measurement (7th), held at Columbus, OH. on October 26-28, 1982, p905-919.			9:28878
84-152610	NTIS, PC A06/MF A01			9:28664
84-152628	NTIS, PC A03/MF A01			9:28665
84-152644	NTIS, PC A05/MF A01			9:28666
84-152685	NTIS, PC A24/MF A01			9:28169
84-152834	NTIS, PC A09/MF A01			9:27880
84-152958	NTIS, PC A05/MF A01			9:27819
84-153444	NTIS, PC A06/MF A01			9:29262
84-153899	NTIS, PC A06/MF A01			9:27864
84-153907	NTIS, PC A09/MF A01			9:28588
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84-154004	NTIS, PC A05/MF A01			9:28589
84-154111	NTIS, PC A03/MF A01			9:28704
84-154178	NTIS, PC A04/MF A01			9:29496
84-154194	NTIS, PC A06/MF A01			9:28718
84-154293	NTIS, PC A10/MF A01			9:28518
84-154848	NTIS, PC A04/MF A01			9:28481
84-154855	NTIS, PC A05/MF A01			9:29393
84-155084	NTIS, PC A02/MF A01			9:29394
84-155092	NTIS, PC A06/MF A01			9:29395
84-155316	NTIS, PC A02/MF A01			9:28705
84-155555	NTIS, PC A04/MF A01			9:28048
84-155563	NTIS, PC A06/MF A01			9:29497
84-155662	NTIS, PC A04/MF A01			9:29254

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84-155712	NTIS, PC A02/MF A01			9:28719
84-155936	NTIS, PC A02/MF A01			9:28706
84-155944	NTIS, PC A03/MF A01			9:29255
84-156009	NTIS, PC A10/MF A01			9:27839
84-156157	NTIS, PC A09/MF A01			9:28590
84-156223	NTIS, PC A04/MF A01			9:28975
84-156280	NTIS, PC A19/MF A01			9:29218
84-156330	NTIS, PC A04/MF A01			9:27810
84-156413	NTIS, PC A08/MF A01			9:28032
84-156496	NTIS, PC A99/MF E15			9:28879
84-156611	NTIS PC E04/MF E01			9:29219
84-156785	NTIS, PC A10/MF A01			9:29220
84-156793	NTIS, PC A99/MF A01			9:29221
84-156801	NTIS, PC A99/MF E04			9:29222
84-157023	NTIS PC E04/MF E01			9:28344
84-157817	NTIS PC E05/MF E01			9:28528
84-157981	NTIS, PC A05/MF A01			9:28076
84-158021	NTIS, PC A07/MF A01			9:27811
84-158203	NTIS, PC AE04/MF E01			9:27896
84-158617	NTIS, PC A03/MF A01			9:29498
84-158807	NTIS, PC A08/MF A01			9:29263
84-159029	NTIS, PC A02/MF A01			9:27790
84-159243	NTIS, PC A10/MF A01			9:27776
84-159359	NTIS, PC A99/MF E04			9:27711
84-159391	NTIS, PC A12/MF A01			9:28681
84-159573	NTIS, PC A06/MF A01			9:27777
84-160886	NTIS PC E04/MF E04			9:28366
84-160936	NTIS, PC A03/MF A01			9:28451
84-160951	NTIS, PC A03/MF A01			9:27831
84-160969	NTIS, PC A02/MF A01			9:28568
84-161025	NTIS PC E04/MF E04			9:28452
84-161033	NTIS PC E04/MF E04			9:28367
84-161306	NTIS, PC A04/MF A01			9:29223
84-161314	NTIS, PC A02/MF A01			9:27881
84-161934	NTIS, PC A02/MF A01			9:27972
84-162346	NTIS, PC A10/MF A01			9:28453
84-162718	NTIS, PC A05/MF A01			9:28033
84-162981	NTIS, PC A10/MF A01			9:28034
84-163062	NTIS, PC A05/MF A01			9:28707
84-163120	NTIS PC E04/MF E04			9:28682
84-163534	NTIS PC E07/MF E07			9:28170
84-163542	NTIS, PC AE03/MF E03			9:28880
84-163583	NTIS, PC AE07/MF E07			9:27948
84-163625	NTIS PC E03/MF E03			9:28591
84-163658	NTIS PC E04/MF E04			9:28454
84-163708	NTIS, PC A04/MF A01			9:27806
84-163872	NTIS, PC A05/MF A01			9:28667
84-163898	NTIS, PC A10/MF A01			9:28683
84-163989	NTIS, PC AE04/MF E01			9:29311
84-164045	NTIS, PC A05/MF A01			9:28544
84-164052	NTIS, PC A03/MF A01			9:27973
84-164144	NTIS, PC A05/MF A01			9:27870
84-164151	NTIS, PC A04/MF A01			9:27871
84-165356	NTIS, PC A07			9:27807
84-166123	NTIS, PC AE04/MF E01			9:27851
84-911504	*See* DOE/NE-0048/5	DE84010683	STD -80	9:28521
PFC/CP-				
84-2	*See* DOE/ET/51013-115	DE84010314	STD -20g	9:29922
84-6	*See* DOE/ET/51013-119	DE84010576	STD -20g	9:29923
84-7	*See* DOE/ET/51013-121	DE84010586	STD -20a	9:29924
PNL-				
4138	*See* NUREG/CR-2803	DE84012491	MN -11	9:29289
4550	*See* NUREG/CR-2955	DE84012057	MN -41	9:27980
4571	NTIS, PC A06/MF A01; 1 (GPO Dep.)	DE84011525	MN -95f	9:28684
4888	NTIS, PC A05/MF A01; 1 (GPO Dep.)	DE84012417	MN -60	9:28242
4912	NTIS, PC A10/MF A01; 1 (GPO Dep.)	DE84012223	MN -95f	9:28685
4927	*See* NUREG/CR-3632	DE84012154	MN -78	9:28443
4952	*See* NUREG/CR-3696	DE84011673	MN -80	9:28364
4960	NTIS, PC A08/MF A01; 1 (GPO Dep.)	DE84012382	MN -90d	9:27778
4983	NTIS, PC A06/MF A01 (GPO Dep.)	DE84012841	MN -90e	9:27832
4990	*See* NUREG/CR-3682	DE84012153	MN -83	9:27981
4991	*See* NUREG/CR-3683	DE84012163	MN -83	9:27982
5000-Pt.2	NTIS, PC A04/MF A01 (GPO Dep.)	DE84007998	MN -11	9:29274
5005	NTIS, PC A05/MF A01; 1 (GPO Dep.)	DE84012514	MN -70	9:27949
5038	NTIS, PC A05/MF A01 (GPO Dep.)	DE84012888	MN -11	9:29244
5049	*See* NUREG/CR-3725	DE84012059	MN -80	9:28365
5055	NTIS, PC A02/MF A01 (GPO Dep.)	DE84012829	MN -91	9:27886
5065	*See* NUREG/CR-3748	DE84012073	MN -78	9:28448
5070	*See* NUREG/CR-3753	DE84012816	MN -25	9:29030
5072	*See* NUREG/CR-3681-Draft	DE84011213	MN -11	9:28446
5119	NTIS, PC A04/MF A01; 1 (GPO Dep.)	DE84012140	MN -80	9:28271
PNL-SA-				
11142	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE84010777	MN -70	9:27983
11565	NTIS, PC A02/MF A01 (GPO Dep.)	DE84011901	MN -41	9:30082
11679	NTIS, PC A02/MF A01 (GPO Dep.)	DE84011877	MN -11	9:29245

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11699-Rev.	NTIS, PC A02; 3 (GPO Dep.)	DE84011862	MN -4	9:28881
11713	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE84008948	MN -70	9:27950
11714	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE84011872	MN -70	9:27951
11719	NTIS, PC A02/MF A01 (GPO Dep.)	DE84010775	MN -37	9:29135
11745	NTIS, PC A02/MF A01 (GPO Dep.)	DE84011875	MN -90a	9:27791
11783	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE84011900	MN -70	9:27974
11796	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE84010899	MN -70	9:27975
11829	NTIS, PC A02/MF A01 (GPO Dep.)	DE84011904	MN -48	9:29499
11835	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE84011882	MN -15	9:27997
11881	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE84011902	MN -25	9:28807
11891	NTIS, PC A03/MF A01 (GPO Dep.)	DE84011898	MN -61D	9:28035
11894	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE84011250	MN -85	9:27921
11898	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE84010680	MN -59a	9:28127
11907	NTIS, PC A02/MF A01 (GPO Dep.)	DE84011897	MN -11	9:29224
11940	NTIS, PC A02; 3 (GPO Dep.)	DE84011361	MN -70B	9:27952
11980	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE84011268	MN -11	9:28510
12026	NTIS, PC A02/MF A01 (GPO Dep.)	DE84011879	MN -61D	9:28036
12081	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE84011686	MN -60	9:28243
12086	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE84010704	MN -85	9:27953
12093	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE84011896	MN -11	9:29303
12116	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE84011870	MN -70	9:28791
12218	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE84011504	MN -25	9:29004
12221	NTIS, PC A15/MF A01; 1 (GPO Dep.)	DE84011491	MN -95d	9:28592
12260	NTIS, PC A02/MF A01 (GPO Dep.)	DE84011880	MN -61D	9:28037
PPPL-				
2095	NTIS, PC A02/MF A01 (GPO Dep.)	DE84011200	STD -20	9:30013
2097	NTIS, PC A02/MF A01 (GPO Dep.)	DE84010934	STD -20g	9:29955
PPPL-Q-				
40	NTIS, PC A05/MF A01 (GPO Dep.)	DE84011480	STD -20	9:30014
PRI-				
76	*See* SAI-84-3032	DE84010843	STD -20g	9:29956
PU-				
84-511	*See* DOE/ER/01428-504	DE84011609	MN -34D	9:29588
R-				
83-38	*See* PB-84-156611			9:29219
REC-ERC-				
83-12	*See* PB-84-143692			9:29308
RFP-				
3275	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE84011603	STD -2	9:28882
3563	NTIS, PC A02/MF A01 (GPO Dep.)	DE84012144	STD -4	9:27912
3614	NTIS, PC A02/MF A01 (GPO Dep.)	DE84012560	STD -4	9:27913
RHO-BW-SA-				
314-P	NTIS, PC A02/MF A01 (GPO Dep.)	DE84011715	MN -70	9:28792
RHO-BW-ST-				
42-P	NTIS, PC A10/MF A01; 1 (GPO Dep.)	DE84011860	MN -70	9:27976
RL-				
83-083	NTIS (US Sales Only), PC A02/MF A01	DE84701677	MN -20	9:30015
SAI-				
84-3032	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE84010843	STD -20g	9:29956
SAI/AFPAT-				
23-30-31-33-34	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE84011201	STD -20g	9:30021
SAN-				
2197-3	*See* DOE/CS/32197-3	DE84007878	STD -59b	9:28151
SAND-				
81-8192/ 2	NTIS, PC A99/MF A01; 1 (GPO Dep.)	DE84012622	MN -62a	9:28128
82-1765	NTIS, PC A03/MF A01; 1 (GPO Dep.)	DE84012913	MN -92	9:27875
83-0319	NTIS, PC A04/MF A01 (GPO Dep.)	DE84012887	MN -71	9:28986
83-0663C	*See* SAND-83-1519	DE84005880	MN -21	9:30022
83-0838	NTIS, PC A05/MF A01; 1 (GPO Dep.)	DE84011535	MN -28	9:28002
83-0956	NTIS, PC A03/MF A01; 1 (GPO Dep.)	DE84011777	MN -70	9:27977
83-1118-Vol.1	*See* NUREG/CR-3300-Vol.1	DE84012384	MN -78	9:28438
83-1385	NTIS, PC A04/MF A01; 1 (GPO Dep.)	DE84012414	MN -15	9:27998
83-1519	NTIS, PC A03/MF A01 (GPO Dep.)	DE84005880	MN -21	9:30022
83-1948C	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE84011256	MN -4	9:28836
83-2028C	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE84010846	MN -63a	9:28077
83-2032C	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE84010973	MN -63c	9:28078
83-2121C	NTIS, PC A02; 3 (GPO Dep.)	DE84010598	MN -70	9:27954
83-2168	NTIS, PC A03/MF A01 (GPO Dep.)	DE84011128	MN -45	9:29162
83-2287C	NTIS, PC A02/MF A01 (GPO Dep.)	DE84009927	MN -70	9:27955
83-2413C	NTIS, PC A03/MF A01; 1 (GPO Dep.)	DE84012241	MN -66	9:28223
83-2551/ 1	NTIS, PC A06/MF A01; 1 (GPO Dep.)	DE84012569	MN -70A	9:27956
83-2576	NTIS, PC A04/MF A01; 1 (GPO Dep.)	DE84011406	MN -45	9:29016
83-2651	*See* NUREG/CR-3629	DE84011840	MN -80	9:28442
83-2670	NTIS, PC A02/MF A01 (GPO Dep.)	DE84011719	MN -94c	9:28482
83-7436/ 1	NTIS, PC A05/MF A01; 1 (GPO Dep.)	DE84012618	STD -70	9:27957
83-7464	NTIS, PC A04/MF A01; 1 (GPO Dep.)	DE84011604	MN -62	9:28190
83-8043	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE84012408	MN -37	9:29155
84-0020	NTIS, PC A03/MF A01; 1 (GPO Dep.)	DE84011789	MN -94e	9:29054
84-0040	*See* NUREG/CR-3639	DE84012523	MN -78	9:28445
84-0097C	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE84005526	MN -80	9:28455
84-0106/ 2	NTIS, PC A02/MF A01 (GPO Dep.)	DE84011627	MN -63	9:28094
84-0111C	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE84011288	MN -63	9:28079
84-0117	NTIS, PC A03/MF A01; 1 (GPO Dep.)	DE84011532	MN -20g	9:30023
84-0125C	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE84010974	MN -63	9:28095
84-0139	NTIS, PC A03/MF A01; 1 (GPO Dep.)	DE84012617	STD -71	9:28987

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84-0142	NTIS, PC A02; 3 (GPO Dep.)	DE84011158	MN -32	9:30083
84-0220	NTIS, PC A04/MF A01; 1 (GPO Dep.)	DE84011470	MN -28	9:29074
84-0228	NTIS, PC A04/MF A01; 1 (GPO Dep.)	DE84012895	STD -90c	9:28988
84-0236	NTIS, PC A02/MF A01 (GPO Dep.)	DE84012896	MN -25	9:28919
84-0311	NTIS, PC A05/MF A01 (GPO Dep.)	DE84012131	MN -13	9:30084
84-0436	NTIS, PC A04/MF A01; 1 (GPO Dep.)	DE84012919	STD -66c	9:28230
84-0506C	NTIS, PC A03/MF A01; 1 (GPO Dep.)	DE84010268	MN -62	9:28129
84-0520C	NTIS, PC A02/MF A01 (GPO Dep.)	DE84011680	MN -94c	9:28483
84-0525C	NTIS, PC A02/MF A01 (GPO Dep.)	DE84008034	MN -38	9:29149
84-0632C	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE84012239	MN -62	9:28187
84-0684C	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE84011193	MN -94cb	9:28484
84-0708	NTIS, PC A03/MF A01; 1 (GPO Dep.)	DE84012877	MN -25	9:28793
84-0771	NTIS, PC A15/MF A01; 1 (GPO Dep.)	DE84012889	MN -25	9:29150
84-0826C	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE84010302	MN -71	9:27922
84-0874C	NTIS, PC A02; 3 (GPO Dep.)	DE84010597	MN -63	9:28096
84-0968C	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE84010977	MN -63	9:28080
84-0992C	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE84011484	MN -63	9:28097
84-1000C	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE84011255	MN -63	9:28081
84-1029C	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE84012281	MN -37	9:29048
84-1049C	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE84011486	MN -15	9:27999
84-7104	NTIS, PC A03/MF A01 (GPO Dep.)	DE84011523	MN -94ca	9:28485
84-8008	NTIS, PC A03/MF A01; 1 (GPO Dep.)	DE84012229	MN -25	9:27833
84-8220	NTIS, PC A03/MF A01; 1 (GPO Dep.)	DE84012035	MN -4	9:28974
84-8717	NTIS, PC A04/MF A01; 1 (GPO Dep.)	DE84010919	MN -62c	9:28130
SERI/SP-				
281-1973	NTIS, PC A07/MF A01; 1 (GPO Dep.)	DE84000095	STD -62	9:28061
SERI/STR-				
231-2206	NTIS, PC A04/MF A01 (GPO Dep.)	DE84004486	STD -61A	9:28082
231-2207	NTIS, PC A04/MF A01; 1 (GPO Dep.)	DE84004500	STD -61A	9:28083
SERI/TP-				
252-2107	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE84000097	STD -62e	9:28471
252-2334	NTIS, PC A02; 3 (GPO Dep.)	DE84004504	MN -62	9:28131
253-2288	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE84004495	STD -62c	9:28171
253-2298	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE84004497	STD -59c	9:28172
253-2299	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE84004496	STD -59c	9:28173
253-2309	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE84004499	STD -59c	9:28174
253-2310	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE84004498	STD -59c	9:28175
253-2324	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE84004501	STD -59b	9:28176
SLAC/AP-				
9	NTIS, PC A02/MF A01; 1 (GPO Dep.)	DE84011557	MN -28	9:29075
21	NTIS, PC A02/MF A01 (GPO Dep.)	DE84012242	MN -28	9:29076
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233	NTIS, PC A02; 3 (GPO Dep.)	DE84011753	MN -28	9:29077
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TD Chad
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TN Tunisia
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TR Turkey
TT Trinidad and Tobago
TW Taiwan
TZ United Republic of Tanzania

UA Ukrainian Soviet Socialist Republic (Ukrainian SSR)
UG Uganda
US United States of America (USA)
UY Uruguay

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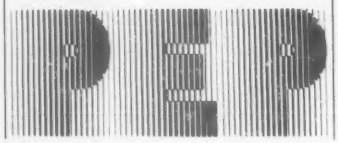

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